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THE UNIVERSITY OF ALBERTA

AN OPERATING COST ANALYSIS MODEL FOR KENYAN TECHNICAL SCHOOLS

by

© TERRENCE EDWARD HARRISON

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF EDUCATION

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled, "An Operating Cost Analysis Model for Kenyan Technical Schools" submitted by Terrence Edward Harrison in partial fulfilment of the requirements for the degree of Master of Education.

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Date. Oct. 17, 1977. . .

ABSTRACT

This study was conducted to develop a model for analysing the operating costs of Kenyan Technical Schools and to apply this model by collecting and analysing the 1975 operating costs in six technical schools. 1975 was opportune because it was the first year these schools had fully implemented a new programme.

In developing the model, numerous cost analysis studies were reviewed, and useful principles and procedures adapted for use in Kenya. Total educational costs were structured and categorized, using Kenyan school account categories where possible. Where necessary salary costs were prorated on the basis of student contact time, and repair and maintenance costs on the basis of use time.

Numerous limitations of the data were cited, most of which could be overcome by utilizing the model to conduct similar studies in successive years on the larger number of schools which were soon to be operating the programme.

The model functioned adequately during its application to the 1975 operating costs. Results indicated (a) definite economies of scale for subject options with larger enrollments, (b) lowest aggregate unit costs for schools in the 400 to 500 enrollment range, (c) that extreme variations could be identified and should be investigated, and (d) that outputs of the model could be useful in planning and budgeting.

It was concluded that the model would be useful in

studying the operating costs in successive years and that the Ministry should be cautious in implementing low-enrollment options or in designing schools with enrollments significantly below 400 or above 500.

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Chapter I

Orientation to the Problem

In 1975 non-degree technical training in Kenya was conducted by the Ministry of Education at three levels in three different programmes. Industrial Education, a single-subject course, formed part of the general academic secondary school programme. Polytechnic Technician Training consisted of post-secondary technical courses leading to a variety of technician diplomas. Technical Education, essentially a pre-vocational programme, was conducted in special Secondary Technical Schools and resulted in a certificate roughly equivalent to the British "O" level or senior matriculation.

The format of the four-year Technical Education Programme was established in 1972. By 1975 the programme as described in Figure 1 was being offered in nine technical schools, six of which had fully implemented it and were graduating approximately 800 students annually. The academic subjects were common to all students in each year. In the first two years the technical subjects were common to all students. The third year students were separated into general orientation programmes in either the building trades or the engineering trades. In the fourth year the students specialized in one trade option. An overview of the programme components, therefore, highlights (a) an academic core, common throughout, (b) three years of

TECHNICAL EDUCATION PROGRAMME

TECHNICAL SUBJECTS		ACADEMIC SUBJECTS
Woodwork, Metalwork, Technical Drawing	YEAR I & II GENERAL INTRODUCTION	Math, Science, English, Kiswahili plus one of History or Geography
BUILDING TRADES OR ENGINEERING TRADES - Technical Drawing - Carpentry/Joinery - Plumbing - Masonry - Technical Drawing - Mechanical - Electrical - Automotive or Agric. Mechanics	YEAR III TRADES ORIENTATION	Math, Science, English, Geography
BUILDING TRADES - Technical Drawing plus one of: - Carpentry/Joinery - Masonry - Plumbing ENGINEERING TRADES - Technical Drawing plus one of: - Mechanical - Electrical - Automotive - Agric. Mechanics	YEAR IV SPECIALIST YEAR	SAME AS YEAR III

Figure 1

SCHEMATIC DESCRIPTION OF THE TECHNICAL EDUCATION PROGRAMME

non-specific technical study, and (c) one year of specialized technical study.

Kenya Government long-range planning had placed considerable emphasis on industrialization and Kenyanization of industry. Technical Education, therefore, was one of the elements to receive priority allocation of development funds. In 1974 the Technical Education Programme was allocated some $9 million for capital development. These funds, to be spent in the years 1975 to 1980, would upgrade and expand nine existing schools and build two new ones. Enrollment was projected to expand from 3400 to approximately 5000 by 1980.

Decisions for expansion of the programme were based on the best available knowledge of Kenya's projected manpower requirements, the post-secondary training structure, the available intake, and the capital costs of providing facilities. Decisions to develop specific courses or to build institutions of a given size were being made using little or no information on operating costs. Moreover, the budget of the Ministry of Education was viewed by government as consuming a disproportionately high percentage of the Republic's total annual expenditure.

J. Vaizey (1967) wrote, "There is no administrator in the world who has more resources than he can use; and when resources are limited, choices have to be made. It is

essential that these choices are based on an accurate assessment of the cost situation" (p. 11). An accurate, comprehensive study of all the programme costs incurred in offering the Kenya Technical Education Programme was beyond the resources of the writer because the basic records and accounting system were not adequate for this purpose. Information about the total operating costs of the programme and the seven specialist programme options was of interest to planners and was not previously available. Therefore, this study was conducted in order to (a) provide a model, the use of which would assist planners by increasing their knowledge of the operating cost implications of technical education programme options and institutional size alternatives, and (b) collect and analyse data on the operating costs of the Technical Education Programme in 1975.

Statement of the Problem

This study attempted to identify certain unit operating costs by programme and by school in six Kenyan technical schools during 1975. Answers to the following questions were sought: (a) what differences existed among the 1975 unit operating costs of the seven options in the Technical Education Programme? (b) what differences existed among the 1975 unit operating costs for the six schools offering the complete four year technical education programme?

Answers to the following sub-problems were required:

1. What were the 1975 unit costs for professional staff salaries for each technical subject option?

2. What were the 1975 unit costs for instructional materials for each technical subject option?

3. What were the 1975 unit costs for maintenance and repair for each technical subject option?

4. What were the unit operating costs by category for each school for 1975?

5. What were the aggregate unit operating costs for each school for 1975?

Cost Analysis

Usefulness. Unit-cost analysis can have a variety of uses in education. Knezevich (1967) states, "The fundamental purpose of unit cost analysis is to present and interpret data as an aid to administration of public education" (p. 204). Mort, Reusser, and Polley (1960) wrote, "Accurate analysis of costs is essential to effective control of the educational enterprise and is an aid in explaining the work of the schools to those who are interested" (p. 40). Myroon (1969) referring to cost analysis wrote, "Finally, the analysed results are used to speculate on reasons for differences in costs, ways to increase efficiency, means of improving the educational programme, assistance in formulation of the budget, deployment of results to the public to elicit their support to predict future trends, as well as a host of other reasons" (p. 3).

In this study the primary use of unit cost analysis is to provide planners with information about the operating costs of the seven technical education programme options and the operating costs of six technical schools. The information assembled could not be either totally accurate or absolutely complete. It was anticipated, however, that information resulting from this study would be useful to planners in developing an understanding of what components comprise costs and how changes in these components could affect cost levels.

Other uses of this cost analysis are possible in the area of budgeting and for the identification of extreme cost variations. Investigations of these extreme variations may point to ways of improving the efficiency of the programme. Any such uses of the results of this study, however, must take into account the specific limitations of the study and the following general potential dangers in the use of cost data.

Potential dangers of cost analysis. The dangers of making cost analysis information available are mainly in the potential misuse of the data. Incorrect comparison, preoccupation with costs alone to the detriment of qualitative assessment, and overestimation of the accuracy of results are all possible. Hull (1961) in summing up his monologue on the pitfalls in the use of unit cost studies pointed out, "It should be stated in conclusion, however,

that the positive benefits of cost studies far outweigh their disadvantages. The need is for more refinement in their construction, more understanding of their nature, and more intelligence in their use" (p. 376).

Cost analyses included in this study deal with specified expenditures related to the provision of the programme. Other identifiable costs such as capital use costs, systems overheads, and opportunity costs exist and each should be examined in regard to its usefulness when attempting to achieve broader objectives. As Hull states, "Attempts may also be made to compare units that are not comparable in nature. When cost studies are made available the temptation to institute comparisons frequently proves irresistible. Many comparisons are meaningful and helpful, but an understanding of the exact nature of the units being compared and the way costs are involved in them is essential" (p. 375).

Cost analysis as used in this study is purely quantitative. No attempt has been made to examine the quality of the unit product or the value to Kenyan society of the product. This study attempted only to determine, as accurately as feasible, certain specified unit costs. Cost-efficiency or cost-benefit considerations are not included.

Delimitations of the Study

This study is delimited (a) to the technical schools administered by the Ministry of Education, Republic of

Kenya, (b) to the six schools which have fully implemented the Technical Education Programme adopted by the Ministry of Education in 1972, and (c) to the annual recurrent costs of operating these schools in 1975.

Limitations of the Study

Limitations of the study were anticipated in three areas potentially affecting the accuracy of cost data.

Limitations due to accounting procedures. Money was spent in Kenyan schools at the discretion of the Headmaster within the amounts provided for each approved expenditure category. By regulation, any expenditure exceeding the approved amount in any category should have been the subject of a request for additional funds or a request to transfer funds from one category to another. Accurate school accounts should have provided accurate details of expenditure. In practice, the accounting regulations were from time to time circumvented by Headmasters and Bursars, producing inaccurate expenditure figures. The possibility of inaccurate school accounting must be considered a limiting factor especially for school-to-school comparisons.

Limitations due to period. 1975 was the first year in which the schools being studied were operating completely on the new Technical Education Programme. The study was, therefore, based on expenditure records that may not accurately reflect the costs as they will be in each category

after the programme has been operative for some time. One source of possible error could be heavier than normal expenditure on instructional materials where durables like masonry blocks or plumbing fittings were purchased in 1975 but might be used again in subsequent years. Another could be heavier than normal expenditures in various categories due to the inexperience of the staff in various departments. A rapid Kenyanization of the Technical Education teaching staff led to a drastic lowering of the age and experience level of the technical teaching staff in each school during the period 1972 to 1975. This inexperience could have resulted in cases of improper ordering, use of inappropriate materials, failure to recycle materials where possible and a lack of knowledge of inexpensive sources of supply. Yet another source of error could be due to the fact that expenditures on repair and maintenance categories are affected by the age of the buildings and equipment. For example, a school that replaced its truck or its mechanical workshop equipment in 1974 would likely show a considerable drop in maintenance expenditure on those items in 1975. Variations of this nature would be most pronounced in school-to-school comparisons.

Limitations due to school personnel. Personalities within a school staff can profoundly affect expenditures. Variations in the actual amounts required to operate certain courses can occur when the people in charge allow

disproportionate amounts to be spent on favoured or high-interest areas.

Definitions

Consistent treatment of data, comparability of results, and the ability of other researchers to replicate a cost analysis study are all dependent on the accuracy and completeness of the definitions of terms used throughout. Most terms which require definition in this study are dealt with as they appear in the text. The following terms, however, are used in numerous places in the text and are, therefore, defined here.

Operating costs. Operating costs are those costs that recur periodically in the offering of instruction. Equipment items with a purchase value of less than 1000 Kenyan shillings and a life expectancy of less than one fiscal year are included as operating costs.

Capital costs. Capital costs are those associated with acquiring assets such as land, buildings, equipment, furnishings, and service connections that are of permanent nature. An arbitrary figure of 1000 Kenyan shillings was chosen to distinguish capital items of equipment and furnishings from operating items.

Programme specific operating costs. These costs are allocable to a specific course and are incurred only for the provision of instruction in that course. Examples are

teachers salaries, instructional materials, and equipment maintenance.

General operating costs. These costs are incurred in keeping the educational plant functioning regardless of the course pattern or emphasis within the curriculum. Examples are boarding costs, fuel, electricity, administration costs, grounds and building maintenance costs.

Costs and expenditures. These two terms are used interchangeably in this thesis and are defined as the financial sacrifice involved in obtaining goods and services.

Unit cost. Unit cost in this study refers to annual per student cost. Unit costs are derived by dividing the total annual expenditure in a category by the official enrollment figure relevant to the cost category. For general operating cost categories this would be the official mid-term enrollment for the whole school. For programme specific operating costs the official mid-term enrollment in the course is used.

Salary. This includes basic salary and all paid benefits.

Professional staff. Professional staff are defined as all those who have direct responsibility for instruction or the supervision of teachers.

Ministry. This refers in all cases to the Ministry of

Education, Republic of Kenya.

Summary

This study was conducted to develop and apply a model which would provide certain information about the annual operating costs of six technical schools in Kenya. The findings provided previously unavailable data on the 1975 unit operating costs of the seven technical education programme options and the 1975 aggregate unit operating costs of each of the six schools. The study was important in that planners in the Ministry of Education were embarking on a large expansion programme and had little or no information on operating costs. The results of this study were intended to assist Ministry planners by offering some insight into the components of operating costs. In addition, if the model is used to determine unit costs in succeeding years the longitudinal information could be valuable to the yearly budgetting exercise as well as to administrators attempting to examine cost-efficiency within the system.

Future Chapters

Chapter II is concerned with the defining of a cost structure that would permit the useful categorization of costs, the establishment of proration methods, and the determination of the unit which is to be used. Chapter III describes the data sources, collection procedures, and treatment of the data. The data required by the specific

sub-problems are presented in numerical and graphic figures in Chapter IV. The various schools and courses are compared and the findings delineated. Chapter V discusses the conclusions that are possible as a result of the findings of Chapter IV and presents recommendations for further research.

Chapter II

Design of the Study

All unit cost analyses require a plan or design to establish parameters and definitions that allow consistency in the collection and treatment of data. The conducting of this study involved five phases as illustrated in Figure 2. The problem has been defined in Chapter I. This chapter deals with the definition and categorization of costs and the establishment of procedures for the collection of data.

Categorization of Education Costs

Many types of costs are incurred in the provision of instruction. To conduct this study it was necessary to categorize these costs to clearly separate those that were irrelevant. Unit cost studies reviewed by the writer revealed a variety of approaches to categorization of costs and no single method was promoted as having distinct overall advantages. Therefore, the utility of the categories for the purposes of the study was used as a basis for establishing cost categories. Figure 3 outlines broad categories of educational costs.

The Operating Costs of each technical school were categorized for budgeting purposes by the Ministry of Education on broad functional lines as follows:

1.0. Personal Emoluments

- 1.1. Non-Teaching Executive Staff
- 1.2. Junior/Subordinate Staff

PHASE 1	PHASE 2		PHASE 3	PHASE 4	PHASE 5
Identify and Define the Problem	Define Costs, Categories of Costs and Proration Method	Establish Data Collection Procedures and Instruments	Collect Data and Calculate Costs	Analyse Costs	Present Findings and Conclusions

Figure 2

PHASES IN THE CONDUCT OF THE STUDY

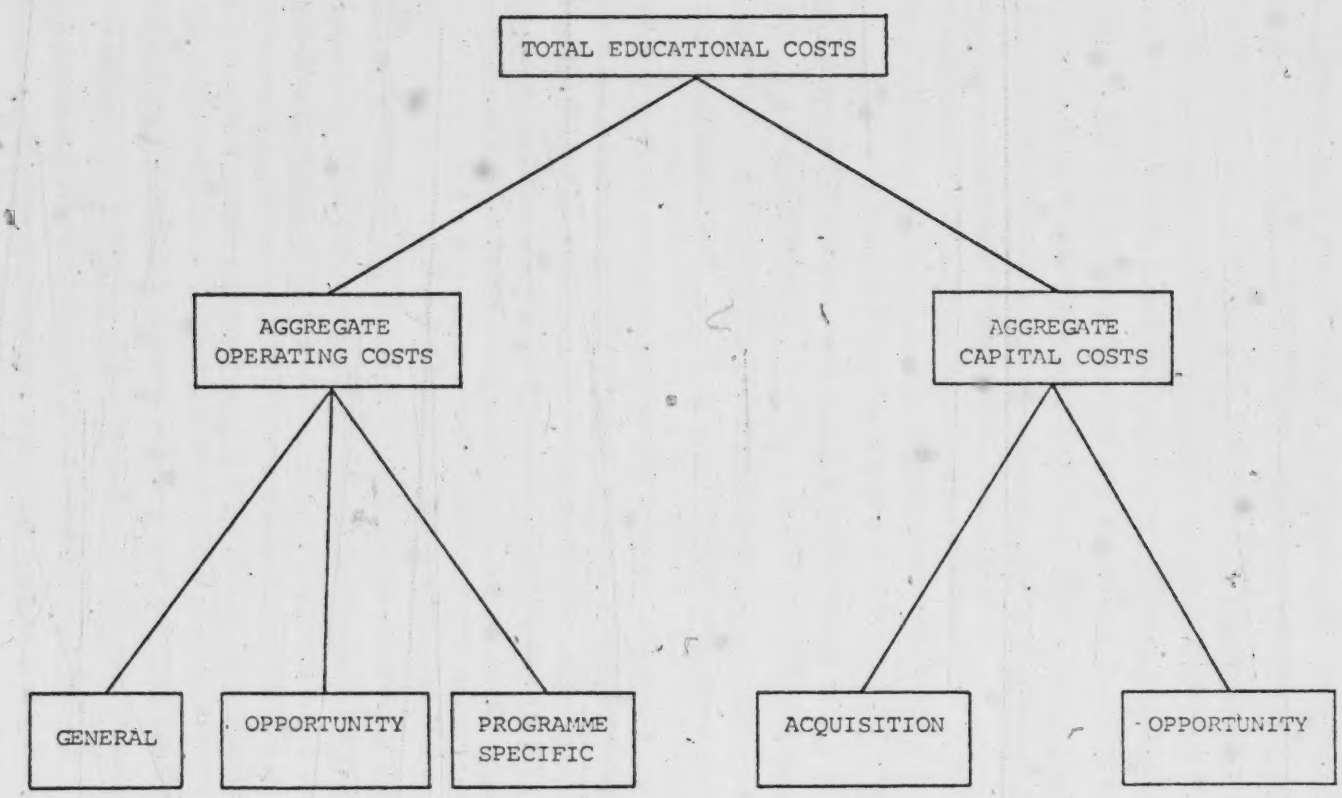

Figure 3

COMPONENTS OF TOTAL EDUCATIONAL COSTS

2.0. Tuition and Boarding

2.1. Tuition Equipment and Stores
2.2. Boarding Equipment and Stores

3.0. Other

3.1.0. Local Transport and Travelling
3.1.1. Internal Transport and Travelling Expenses
3.1.2. Vehicle Insurance, Registration
3.1.3. Board of Governors

3.2.0. Electricity, Water and Conservancy
3.2.1. (2) (3) Electricity, Water and Conservancy Charges
3.2.4. (5) Fuel and Maintenance of Plants

3.3.0. Contingencies

3.4.0. Repairs, Maintenance and Improvements
3.4.1. Maintenance and Minor Repairs of Equipment including furniture (non-instructional)
3.4.2. Minor Repairs and Maintenance of Buildings
3.4.3. Maintenance of Grounds
3.4.4. Machinery Repairs and Maintenance (instructional)

Teachers' salaries do not appear above because the responsibility for providing teaching staff was a separate administrative function assigned to The Teachers Service Commission. This separate legal entity, funded by the Ministry of Education, was charged with complete responsibility for employing, assigning, and paying the teaching staff of all Ministry of Education maintained schools. Records of teaching staff assignments and salary were available in the schools.

Figure 4 illustrates categories of educational costs

with illustrative examples of item heads from the Ministry of Education's Budget Accounts.

Description of Categories

This study was concerned with Operating Costs which are illustrated in Figure 4 as one component of Total Educational Costs. The other component, Capital Costs, is discussed here in an attempt to place the Operating Costs in a perspective and to demonstrate possible categories that could be used to account for costs that were excluded from this study.

Aggregate Capital Costs

Capital Costs were defined as the costs of acquiring and keeping assets such as land, buildings, equipment, furnishings, and service connections that are of a permanent nature. The costs of acquiring capital assets (Acquisition Costs) involve purchase costs plus debt-service costs on any monies borrowed to purchase an asset.

Acquisition costs. These costs were the actual purchase price paid for capital items plus all other expenditures for tendering, transport, installation, and legal work. Items such as land and buildings were easily identified within this category but some problems arose in categorizing certain recurrent equipment and supply items that had a life expectancy extending over more than one fiscal period. Zymelman (1973) in a survey of 55 technical

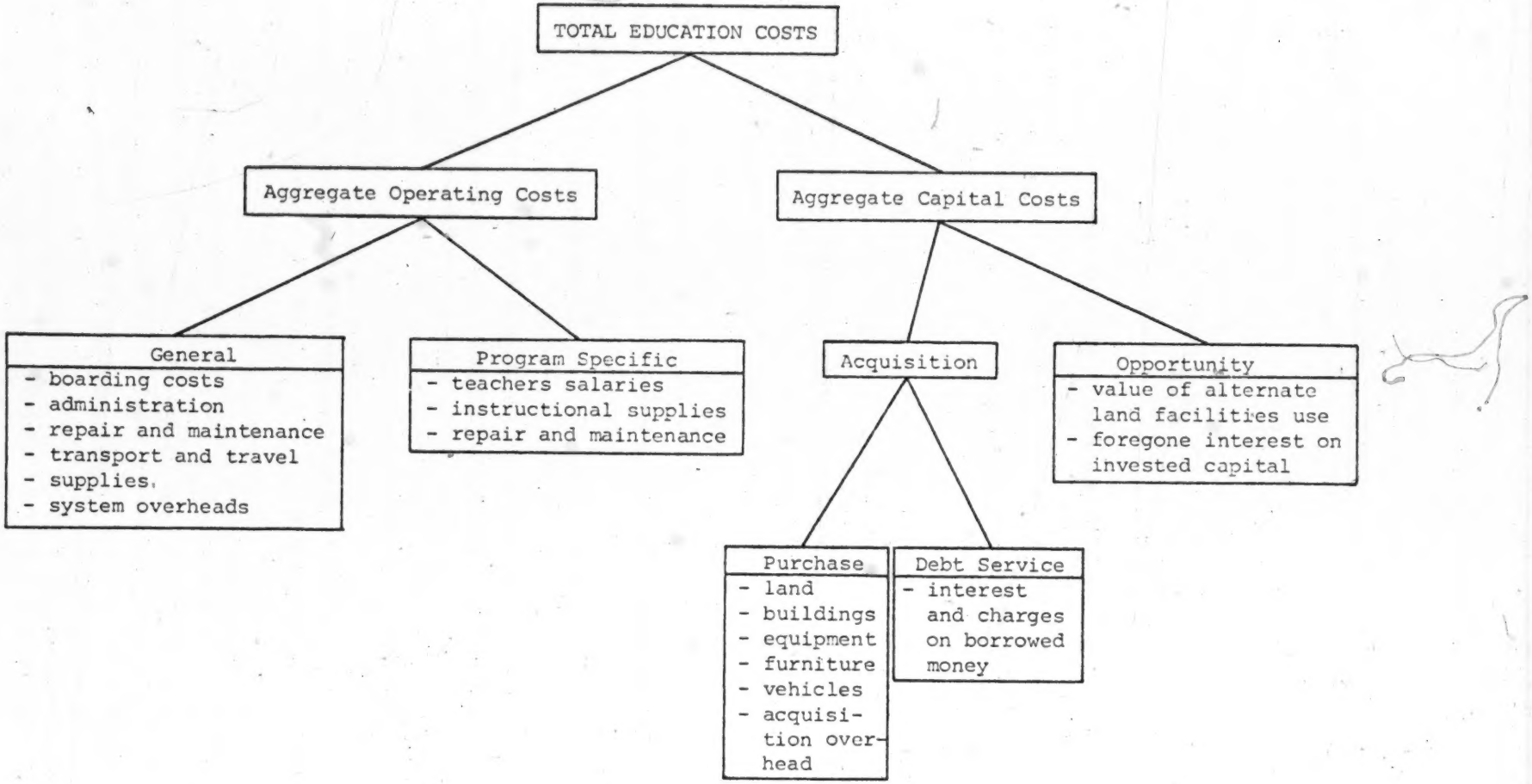

Figure 4

MAJOR COMPONENTS OF EDUCATIONAL COSTS
(WITH ILLUSTRATIVE EXAMPLES OF ITEM HEADS)

education cost studies for the International Bank for Reconstruction and Development found no consistent method for determining the point at which an item ceases to be an operating expenditure and becomes a capital expenditure. He resorted to an arbitrarily set value in the model he established (p. 4-7). For the purposes of this study Capital Purchase Costs are defined as expenditures for physical resources with a life expectancy of more than one fiscal year and with an item cost in excess of one thousand Kenyan shillings.

Renting or leasing educational facilities for education had not been a practice in the Kenyan Ministry of Education and, therefore, is not discussed.

Capital opportunity costs. Keeping capital assets, whether they are used or not, involves certain costs. Ziemer, Young, and Topping (1971) state "Opportunity cost, in the economic sense, is a benefit foregone. Any resource with alternative uses that is committed to the production of higher education outputs is a component of the cost of purchasing those outputs" (p. 117). The potential value of alternate land facilities use plus the foregone interest on invested capital are two examples of Capital Opportunity Costs.

Aggregate Operating Costs

For the purposes of this study Operating Costs were defined as all annually recurring costs such as salaries,

supplies, services, plus all equipment and furnishings that did not meet the acquisition cost criteria of items described as capital assets.

General operating costs. These expenditures included all those operating costs that were not directly related to the provision of instruction for a specific programme. This definition offers very clear cut direction for the allocation of such costs as administrative salaries, boarding costs, system overheads, and site maintenance. However, certain costs such as electricity, water, some maintenance and repair, transport and travel posed a special problem. For example, a mechanical workshop without electrical power would be next to useless, therefore, it must be said that the electricity cost is directly related to the provision of instruction within the mechanical programme. A very costly load and duty-cycle survey would be required to estimate the proportion of the school's electricity bill allocable to each programme option. A further example involves transport. The school vehicle collects two cylinders of acetylene for welding shop in addition to the month's maize supply for the kitchen. The calculation and proration of costs for such trips would be very time consuming. For the purposes of this study such cross-category expenditures were all arbitrarily held to be General Costs because the costs of prorating these expenditures was prohibitive.

Determination of Relevant Costs

Determination of the cost categories required to solve the problems as expressed in Chapter I necessitated the examination of each problem individually. The first major problem was to determine what differences existed among the 1975 unit costs of the seven options in the Technical Education Programme. This problem involved three sub-problems.

Professional staff salaries. In order to determine the unit professional staff salary costs of each technical education subject option it was necessary (a) to find the salary of each professional staff member who was fully engaged in teaching that option, (b) to pro-rate the salary of each professional staff member who was partly engaged in teaching that option, and (c) to calculate the unit cost.

Proration of professional staff salaries. The fundamental purpose of proration is to allocate parts of a single expenditure to different functions in proportion to the benefits which the expenditure provided to each function.[1] In relation to the professional salaries costs of the technical education options being studied two methods appeared possible: (a) by contacting each member concerned and using his/her personal estimate of the percentage of

[1] An excellent, concise review of the reasons for proration, methods of prorating, and criteria for selecting methods of prorating can be found in Myroon (1971, p. 43-50).

time spent on each activity or (b) by employing the formula:

$$\frac{CPo}{CPt} \times \text{salary} = \text{allocable cost}$$

CPo = contact periods per week in subject option

CPt = total contact periods per week by specific teacher

o = subject option being studied

CP = periods on the weekly timetable where the staff member had direct responsibility for instruction or student supervision

The second method was chosen because it was not feasible to contact all of the staff who were in the schools in 1975. This method, however, required additional adjustment in the cases of the Headmasters and Deputy Headmasters who were, by Ministry policy, expected to devote time to administration. During 1975 in Kenya's Technical Schools a normal teaching load was considered to be 30 contact periods per week out of a total of 45. Headmasters were expected to teach one subject or eight periods per week. This figure of eight periods per week was used to divide the Headmaster's salary between administration and programme specific duties when he was involved directly in a subject option being studied, i.e. $\frac{8}{30} = .27$.

Deputy Headmasters were expected to teach at least half time. Therefore, .5 of the annual salary was used for proration when he was involved in teaching of one

of the options in the study. The formula was amended as follows:

Headmasters:

$$\frac{CPo}{CPt} \times .27 \text{ Salary} = \text{allocable cost}$$

Deputy Headmasters:

$$\frac{CPo}{CPt} \times .5 \text{ Salary} = \text{allocable cost}$$

All other staff were treated alike whether or not they accepted extra duties such as department heads, sports coaching, library work, or club activities.

The data was collected on a form entitled "Professional Staff Salary-Cost Per Option". A sample is included in Appendix B, page .

Instructional materials. Kenya Technical School main office accounts do not separate the expenditures for instructional materials by subject, level, or even department. In order to determine the expenditures allocable to the fourth year technical subject options it was necessary to visit each school and contact the Headmaster, Bursar, and relevant department heads. Actual figures were used where it was discovered that departmental records had been kept. Where no records were available the department heads and the bursars were asked to list and value the supplies and materials used in the course. Only programme-specific supplies and materials were considered. Articles such as notebooks, pencils, examination booklets, and other general

stationery supplies were deemed a general cost. The data collection form is included in Appendix B on page .

Maintenance and repair. The main school accounts did not break down maintenance and repair expenditures. The lack of any breakdown was a problem which was compounded by the fact that this study required a proration of the repair and maintenance costs for workshop equipment that was used jointly by the fourth year subject option students and students enrolled in other years of the programme. Repair and maintenance expenditures for each workshop were determined by collecting expenditure figures in the schools. Costs for workshops used jointly were prorated as follows:

$$\frac{ppw_o}{ppw_t} \times \text{expenditure} = \text{allocable cost}$$

ppw_o = periods per week workshop was used by students of the option o

ppw_t = total periods per week the workshop was scheduled for use

The data collection form for Maintenance and Repair Expenditures is included in Appendix B on page .

Aggregate operating costs. The second major problem of this study was to determine what differences existed among the 1975 aggregate per-student costs for the six schools operating the complete four-year technical education programme. The sub-problems were to determine (a) unit operating costs by category for each school for

1975 and (b) aggregate unit operating costs for each school for 1975.

The categorization of costs developed at the beginning of this chapter accommodated the Kenya Technical School account headings easily. To the relevant school account headings 1.0. - Personal Emoluments, 2.0. - Tuition and Boarding, and 3.0. - Other Charges was added the annual expenditure on Professional Salaries. The data collection forms used to compile these required figures are included in Appendix B on pages

Opportunity operating costs. The employment situation in Kenya in 1975 allowed very little chance of employment for primary school leavers. Therefore, the opportunity cost which was foregone by students in order to attend technical school was very small but might have been valued by calculating the students' potential usefulness in the agricultural sector.

The opportunity cost of using resources to pay the operating expenditures for technical schools leads directly into the controversial area of quantifying benefits. The calculation of the benefit derived from spending operating funds on the technical school programme as opposed to another programme was beyond the scope of this study. Opportunity costs were not calculated or used as part of this study.

Determination of Unit

Unit cost analysis studies reviewed by the writer used either the average daily attendance or the average daily enrollment (membership) as the basic unit. In the Kenyan educational system there is a severe shortage of secondary school places. Approximately one out of every ten primary school leavers finds a place in a secondary school. This situation encourages very keen competition for secondary school places. In addition, technical education had been enjoying a degree of popularity in the few years prior to 1975 which made the competition for places in the secondary technical schools even more intense than in the general academic secondary school. Given this very high motivation to attend and the fact that student vacancies due to illness, death, or expulsion were usually filled immediately, the actual recorded enrollment at mid-term was considered a suitable basis for the unit. Unit costs were calculated by dividing the annual expenditures by the actual recorded enrollment at mid-term.

Summary

This chapter detailed the cost categories and proration procedures necessary for assembling the data required to answer each of the sub-problems. The rationale was given for definitions, proration procedures, and the choice of unit. Samples of the data collection forms which were developed are included in Appendix B.

Chapter III

Data Collection and Treatment

The data required for this study was collected over the period April to August, 1976. Collection of expenditure data before April was impossible due to the internal trial balance work and bank reconciliations that are undertaken in the schools each quarter for the previous quarter's accounts.

Data collection proceeded according to Figure 5.

Data Sources

Professional staff salaries. A search of the staff assignment records kept in the Ministry by the Technical Education Section provided the bulk of the data required on Professional Staff Salaries. This data, however, contained numerous inaccuracies in regard to teachers who were transferred during the year, actual timetabled teaching load, and exact salary. These inaccuracies were corrected by checking each of the items in each school. Precise records of salary and transfers were available in the schools and the 1975 timetable records allowed correction of any errors in the teaching load allocations which existed in the Ministry files. In any replication of this study it would be possible to circulate the data collection forms to the Headmasters for completion in advance of a final collection visit, thereby considerably reducing the time and travel required. No search of Ministry records would be necessary

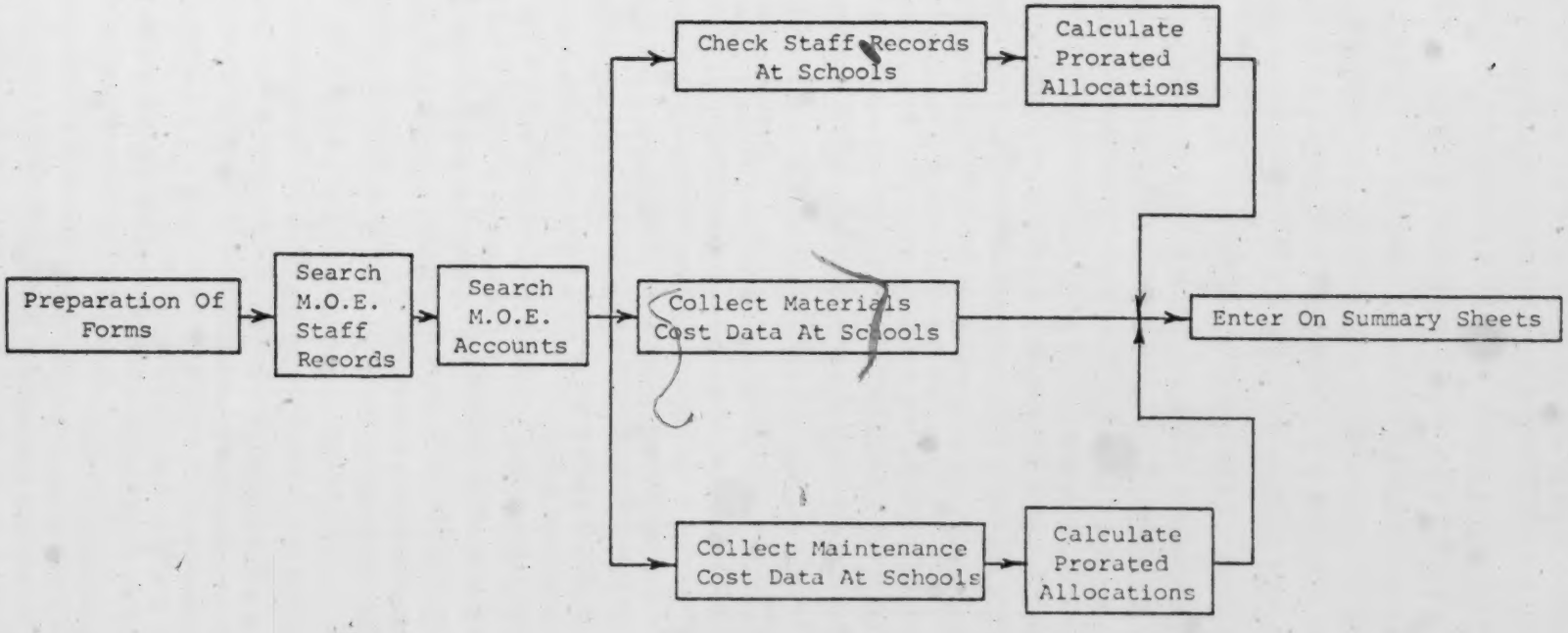
Preparation Of Forms
Search M.O.E. Staff Records
Search M.O.E. Accounts
Check Staff Records At Schools
Collect Materials Cost Data At Schools
Collect Maintenance Cost Data At Schools
Calculate Prorated Allocations
Calculate Prorated Allocations
Enter On Summary Sheets

Figure 5

DATA COLLECTION ACTIVITIES

in this case. It was only done during this study to shorten the time required at each school.

Staff vacancies. 1975 unit operating costs for the schools and programmes involved were obviously affected by the number of vacancies that existed in the school staffs. School by school vacancy variations could result in pronounced unit cost variations for salaries. In the system as a whole, vacancies were a perennial problem. It was possible to minimize the effect of vacancies on unit costs by inserting a fictitious mean salary into the costs of each school where a vacancy existed and then treating the workload and allocation normally. This, however, would produce both fictitious total costs and fictitious unit costs. Neither of these cost figures would be useful because fictitious costs and actual costs would be mixed in such a way that the two could not be readily separated by someone attempting to analyse the costs.

For the purposes of this study it was decided that the best course of action was to ignore staff vacancies in the cost calculations because (a) the system will likely have vacancies at all times in the foreseeable future so that costs calculated at full staff complement would be unrealistic, and (b) if vacancies are a factor in the unit cost of any particular category then it is best that they be examined separately when considering the actual unit costs in each case. By examining the vacancies separately

the extent of variation attributable to these vacancies can be clearly understood.

Changes in teaching assignment. A number of cases were encountered where the total teaching load or the assignments within an instructor's total teaching load were altered during 1975. When this affected the costing of a technical subject option the teaching assignment pattern that had been used most during 1975 was used for the allocation of salary costs.

School Accounts

In 1975 the Ministry of Education, Technical Education Section initiated an attempt to encourage the keeping of accurate, detailed accounts by the schools. Schools were asked to produce monthly summaries of expenditures within the categories detailed on pages 14/17. The Technical Education Section had aggregated these 1975 monthly summaries and used the figures to produce the 1976 budget summaries. The aggregated 1975 figures were assumed to be accurate and were collected for each school in the study. However, during the school visits a check of the accounting procedures showed that, in all but one case, only 8 of the 15 accounting categories were actually used in the schools. These eight categories were:

1.1. Personal Emoluments - Non-Teaching Executive Staff
1.2. Personal Emoluments - Junior/Subordinate Staff
2.1. Tuition Equipment and Stores

2.2. Boarding Equipment and Stores
3.1. Local Transport and Travel
3.2. Electricity, Water, and Conservancy
3.3. Contingencies
3.4. Repairs, Maintenance and Improvements

For the purposes of the Ministry's requested monthly return the additional sub-categories had been either ignored or estimated. The only accurate figures available in all of the six schools, therefore, were the totals for actual expenditure under eight major categories. These actual expenditure figures were collected in each school because, even though they were not subdivided in as much detail as was anticipated, they did represent the actual operating costs for the school.

School departmental expenditure records. In 1975 the Technical Education Section had also initiated an attempt to encourage each technical department in the schools to operate a simple system of budgets, requisitions, and accounts. This system was proposed in order to (a) allow each department head to be aware of his allocated expenditure for the year, thus enabling him to plan and pace his expenditures and (b) to provide records of costs that could be used to assess various aspects of purchasing, supply, teaching methods, and recycling. This system was only requested, however, and upon investigation in the schools the writer found that, generally, a system of budget and requisitions had been instituted but no departments were keeping accurate itemized records of expenditure. This meant that

the calculation of costs for the seven technical education programme options had to involve estimated rather than actual expenditures for some instructional materials and for repair and maintenance. Each department was, therefore, contacted and required to produce an estimate of the expenditures in these two categories. Since the maintenance and repair costs were for equipment and workshops that were used jointly by students who were not in the options being costed, these estimated expenditures were pro-rated on the basis of use time as described on page .

School Visits

Each of the schools studied was visited twice in the course of the data collection. During the first visit the study was explained to the administration and all data that was readily available was collected. At each school there was a variety of situations that prevented the collection of data in a single visit. Examples of these problem situations were (a) personnel were absent, (b) the books of accounts were not complete or up to date, (c) the books of accounts were at the auditors, (d) the books of accounts had been seized because the administration was under criminal investigation, (e) the figures required by the study necessitated a lengthy item-by-item search, and (f) the estimates required by the study necessitated listing and costing which could not be done immediately.

The information that was not available on the first

visit was clearly outlined and the school administration was asked to assemble it prior to the second visit. On the second visit any remaining problems were resolved and the data collection completed.

Summarization of data. When the final data collection was complete the data were summarized and are presented in Chapter IV as they relate to each sub-problem. Samples of the forms used for summarizing the data are included in Appendix B on pages

Summary

This chapter described details of the collection and treatment of the data. Various problems encountered with the data sources were described and the solutions chosen for use in this study were outlined. The data collection from the Ministry files and school visits took 26 man-days of time and 2352 miles of travel exclusive of proration, summary and analysis.

Chapter IV

Unit Costs

This chapter presents the unit costs derived from data collected and summarized in answer to the sub-problems detailed in Chapter I. The analytical procedures used were computational rather than statistical. The answers to the two major questions of the study are discussed following the solutions to the relevant sub-problems.

Unit Costs of the Technical Education Subject Options

The unit operating costs for each of the seven subject options in the Technical Education Programme were composed of three categories: professional salaries, instructional materials, and maintenance and repair. Only costs defined as programme specific were included, all others being designated General Costs. Kenya shillings are the monetary units used throughout.

Professional Staff Salaries. Sub-problem 1 on page 5 was, "What were the 1975 unit costs for professional staff salaries for each technical subject option?". These unit costs, determined by the methods detailed in Chapters II and III are shown in Figure 6.

Three of the subject options were offered in five of the schools. The other four options were only offered in one school in 1975. Unit costs for professional staff salaries ranged from 269 for automotive in Kisumu to 1,271

Option	Kabete	Kisumu	Rift Valley	Machakos	Thika	Meru	Mean
	Enrollment / Unit Cost						
Mechanical	58 / 435	27 / 1,271	48 / 996	30 / 830	22 / 1,060	-	185 / 841
Electrical	60 / 485	30 / 794	29 / 629	28 / 959	17 / 874	-	164 / 688
Automotive	59 / 773	53 / 269	44 / 300	30 / 368	19 / 759	-	205 / 480
Ag. Mech.	-	-	-	-	53 / 395	-	-
Carp./Join.	-	-	-	-	-	16 / 629	-
Plumbing	-	-	-	-	-	29 / 690	-
Masonry	-	-	-	-	-	45 / 546	-

Figure 6

PROFESSIONAL STAFF SALARIES - UNIT COSTS

for mechanical in the same school. The mean unit cost incurred for professional salaries for all options in all schools was 687. Variations can be attributed to (a) teachers' salaries which varied according to qualifications and years of service, (b) inequities in the assignment of teaching loads, and (c) shortages of teachers or facilities which caused Headmasters to double the recommended class size from 18 to 36, thus reducing the unit cost. Any meaningful comparison of the costs of professional staff salaries must be made in the context of these variations.

Instructional materials costs. For reasons outlined in Chapters II and III it was not possible to collect the actual expenditure data for instructional materials for each option. Sub-problem 2, "What were the 1975 unit costs for instructional materials for each technical subject option?", therefore, involved answers that were, in most cases, estimates. These unit costs are shown in Figure 7. The causes of variation in these unit costs were the three limitations of the study cited in Chapter I plus (a) losses due to theft, (b) misuse of materials, (c) the operation of unauthorized extramural courses, (d) staff changeover resulting in lack of first hand knowledge on which to base estimates when no records were kept, and (e) supplies being purchased from revenues generated from course activities.

The range of unit costs for instructional materials was from 109 shillings for automotives at Machakos to 1,080

Option	Kabete	Kisumu	Rift Valley	Machakos	Thika	Meru	Mean
	Enrollment / Estimated Unit Costs						
Mechanical	58 / 173	27 / 1,080	48 / 192	30 / 190	22 / 278	-	185 / 326
Electrical	60 / 278	30 / 524	29 / 167	28 / 271	17 / 273	-	164 / 302
Automotive	59 / 218	53 / 179	44 / 153	30 / 109	19 / 229	-	205 / 180
Ag. Mech.	-	-	-	-	53 / 151	-	-
Carp./Join.	-	-	-	-	-	16 / 691	-
Plumbing	-	-	-	-	-	29 / 615	-
Masonry	-	-	-	-	-	45 / 206	-

Figure 7

INSTRUCTIONAL MATERIALS - UNIT COSTS

shillings for the mechanical option at Kisumu. The mean unit costs for the mechanical, electrical, and automotive options may be useful in budgeting for future courses. Any such use, however, should take into consideration the causes of variation. The mean unit instructional materials cost for all options in all schools was 314 shillings.

Maintenance and repair costs. The determination of these costs also involved some estimation where accurate records were unavailable. In addition, expenditures for jointly-used workshops were prorated on the basis of use time. The sub-problem, "What were the 1975 unit costs for maintenance and repair for each technical subject option?", therefore, involved answers that were estimates. These unit costs are shown in Figure 8. They ranged from nil for the electrical option at Machakos to 484 shillings for the mechanical option at Kisumu. The mean cost of all options in all schools was 94 shillings. Causes of variations were as cited in the limitations to the study (Chapter I) plus the possibility of inaccurate estimations by bursars and department heads. The limitations due to period are especially relevant here since repairs, while they are termed operating costs, must be made when required. It is, therefore, possible to have very low expenditures one year and very high ones the next, even when all other factors are constant.

Option	Kabete	Kisumu	Rift Valley	Machakos	Thika	Meru	Mean
	Enrollment / Estimated Unit Costs						
Mechanical	58 / 36	27 / 484	48 / 171	30 / 5	22 / 63	-	185 / 135
Electrical	60 / 10	30 / 115	29 / 340	28 / Nil	17 / 41	-	164 / 89
Automotive	59 / 21	53 / 109	44 / 182	30 / 8	19 / 18	-	205 / 76
Ag. Mech.	-	-	-	-	53 / 38	-	-
Carp./Join.	-	-	-	-	-	16 / 103	-
Plumbing	-	-	-	-	-	29 / 28	-
Masonry	-	-	-	-	-	45 / 14	-

Figure 8

MAINTENANCE AND REPAIR - UNIT COSTS

Total Unit Costs for Each Technical Subject Option

The total programme specific costs for each option were the sums of professional staff salaries, instructional materials, and maintenance and repair costs. These totals by option and school are displayed in Figure 9.

The first major question posed in this study was "What differences existed among the 1975 unit operating costs for the seven options in the Technical Education Programme?". Three of the options were offered in five of the six schools. These three options are compared graphically in Figure 10.

Mechanical. The mean unit cost for this option was 1,301. Three schools were grouped near the mean. Kisumu showed the highest cost of 2,835 and Kabete the lowest of 644. These extreme variations may have been caused by administrative problems which troubled both schools in 1975. The other three schools under relatively stable conditions demonstrate more closely-grouped programme costs.

Of the engineering options, mechanical was the most expensive with a mean cost of 1,301.

Electrical. The mean unit cost was 1,079 for the electrical option. Three schools were grouped near the mean. Kisumu at 1,433 again incurred the highest cost and Kabete the lowest at 744. Electrical was the second most costly engineering option.

Option	Kabete	Kisumu	Rift Valley	Machakos	Thika	Meru	Mean
Mechanical	644	2,835	1,359	1,025	1,401	-	1,301
Electrical	744	1,433	1,136	1,230	1,188	-	1,079
Automotive	1,014	555	635	485	1,006	-	736
Ag. Mech.	-	-	-	-	584	-	-
Carp./Join.	-	-	-	-	-	1,423	-
Plumbing	-	-	-	-	-	1,333	-
Masonry	-	-	-	-	-	766	-

Figure 9

1975 PROGRAMME SPECIFIC UNIT COSTS

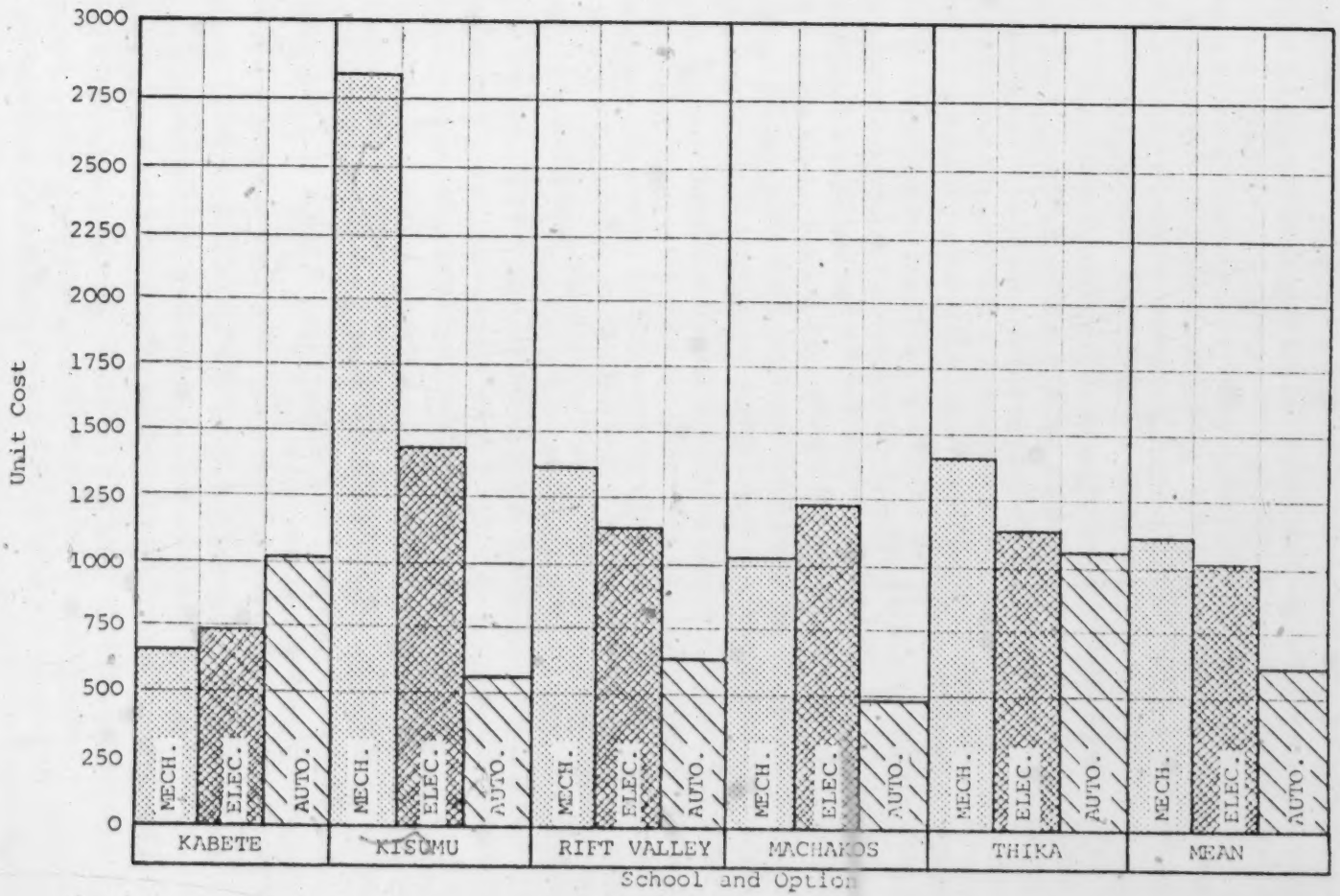

Figure 10

UNIT COSTS - MECHANICAL, ELECTRICAL, AUTOMOTIVE OPTIONS

Automotive. This option had a mean unit cost of 736. Three schools, Kisumu, Rift Valley, and Machakos, had the lowest costs and were grouped fairly closely, while Thika and Kabete incurred considerably higher costs. Automotives was the least costly of the engineering options offered in more than one school.

Agricultural mechanics. This engineering option was offered at only one school in 1975. The unit cost was 584 which was similar to the mean cost for automotives. By 1978 it was anticipated that four schools would be offering this option at which time the larger population could provide more reliable cost data.

The building options. Unfortunately, programmes in the carpentry/joinery, plumbing and masonry options were completely implemented in only one school in 1975. The exercise of determining the unit costs incurred in this school was useful, however, because the model developed for this study was tested and could be used longitudinally in the four other schools which were expected to completely implement the programme by 1978.

The carpentry/joinery option incurred the second highest unit cost of all seven options. Plumbing at 1,333 was somewhat above the mean of 1,095, while masonry at 766 was considerably below.

The unit cost of instructional materials at Meru was more than double the mean cost of instructional materials

elsewhere. The writer was aware of a considerable renovation programme at Meru which was undertaken by the school in 1975. A close scrutiny of expenditures costed as instructional materials may indicate items which were purchased primarily for the renovation work rather than for instruction.

Subject option costs and enrollment. Figure 11 displays the subject option unit costs by school and the enrollment in each option. Certain economies of scale appear to be operative. Generally the options with higher enrollments incurred lower unit costs. Two distinct groups were evident: options with enrollments of 16 to 30, and options with enrollments of 44 to 60.

Enrollment Group	No of Options	Range of Unit Cost	Mean Unit Cost
16 - 30	11	485 - 2,835	1,323
44 - 60	8	555 - 1,359	787

The mean unit cost of the higher enrollment group was 536 shillings less than that for the lower enrollment group, indicating that there is considerable economy for larger enrollments. This may be due to (a) better utilization of specialist teachers, resulting in lower unit costs for professional salaries, (b) better utilization of facilities, resulting in reduced unit costs for maintenance and repair, and (c) economies in purchasing larger quantities of supplies and materials.

ENROLLMENT → XX
UNIT COST → X,XXX

SCHOOL	MECHANICAL	ELECTRICAL	AUTOMOTIVE	AGRIC. MECH.	CARP./JOIN.	PLUMBING	MASONRY
Kabete	58 644	60 744	59 1,014	-	-	-	-
Rift Valley	48 1,359	29 1,136	44 635	-	-	-	-
Kisumu	27 2,835	30 1,433	53 555	-	-	-	-
Machakos	30 1,025	28 1,230	30 485	-	-	-	-
Thika	22 1,401	17 1,188	19 1,066	53 584	-	-	-
Meru	-	-	-	-	16 1,423	29 1,333	45 766
Totals/Mean	185 1,123	164 1,004	205 609	53 584	16 1,423	29 1,333	45 766

Figure 11

SUBJECT OPTION UNIT OPERATING COSTS BY SCHOOL

Aggregate Unit Operating Costs

Sub-problem 4 required the determination of unit costs by category for each school. These categories were detailed in Chapters II and III. The sum of these nine cost categories provided the aggregate unit costs required by the second major question of the study. This problem was to determine what differences existed among the 1975 aggregate unit operating costs for the six schools offering the complete four year technical education programme.

The unit costs per category for each school are displayed in Figures 12 to 20. All costs are in Kenya shillings.

The aggregate unit operating costs for the six schools ranged from a low of 2,467 at Machakos to a high of 3,353 at Thika. The mean was 2,941. Meru and Kabete schools were very near the mean costs while Machakos and Rift Valley were considerably below. Thika and Kisumu incurred unit costs that were higher than all other schools. Thika's high aggregate unit cost was due almost entirely to a high unit cost for professional staff salaries. This was caused by enrollment being purposely reduced in 1975 to accommodate a dormitory construction programme. The professional staff, normally resident at the school and needed again in 1976, were not moved from the school for the single year of reduced enrollment. Professional staff costs comprise roughly one-third of total operating costs. Therefore, the pronounced increase in the unit cost for

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	386,904	328	1,179
2. Thika	643,668	398	1,617
3. Machakos	401,340	428	937
4. Rift Valley	588,011	497	1,183
5. Kisumu	738,840	522	1,415
6. Kabete	736,760	718	1,026
Totals/Mean	3,495,523	2,891	1,209

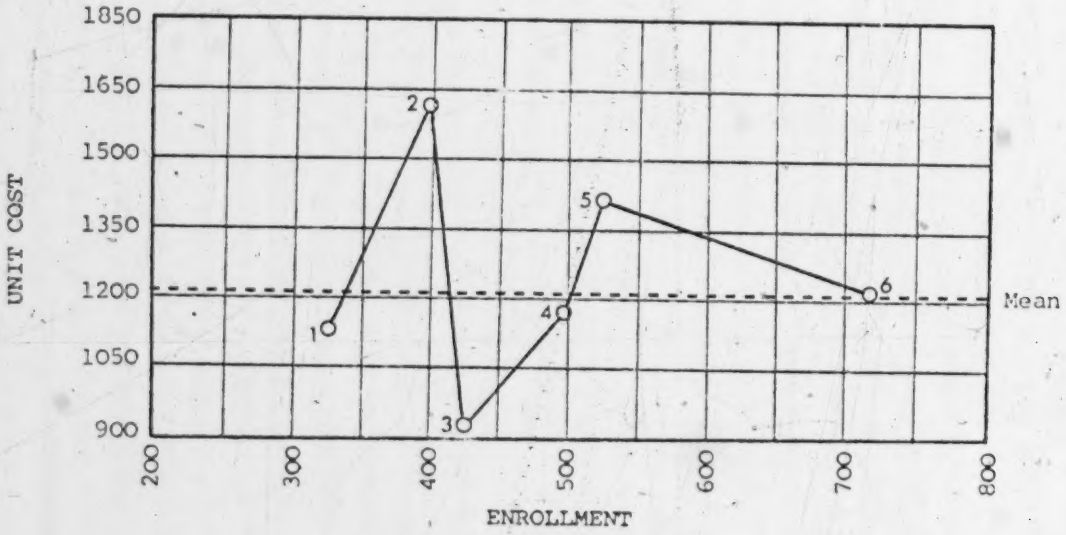

Figure 12

UNIT COSTS - PERSONAL EMOLUMENTS (PROFESSIONAL STAFF)

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	78,172	328	238
2. Thika	72,098	398	181
3. Machakos	80,394	426	188
4. Rift Valley	62,276	497	125
5. Kisumu	119,189	522	228
6. Kabete	170,155	718	236
Totals/Mean	582,284	2,889	202

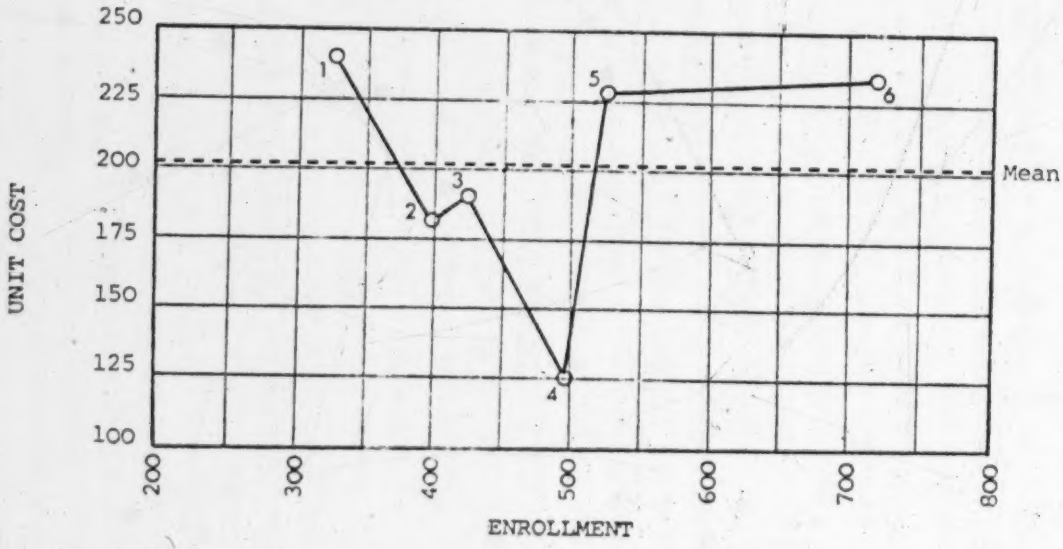

Figure 13

UNIT COSTS - PERSONAL EMOLUMENTS (NON-TEACHING EXECUTIVE STAFF)

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	96,563	328	294
2. Thika	95,356	398	239
3. Machakos	112,678	426	264
4. Rift Valley	107,837	497	216
5. Kisumu	117,416	522	224
6. Kabete	176,057	718	245
Totals/Mean	705,907	2,889	244

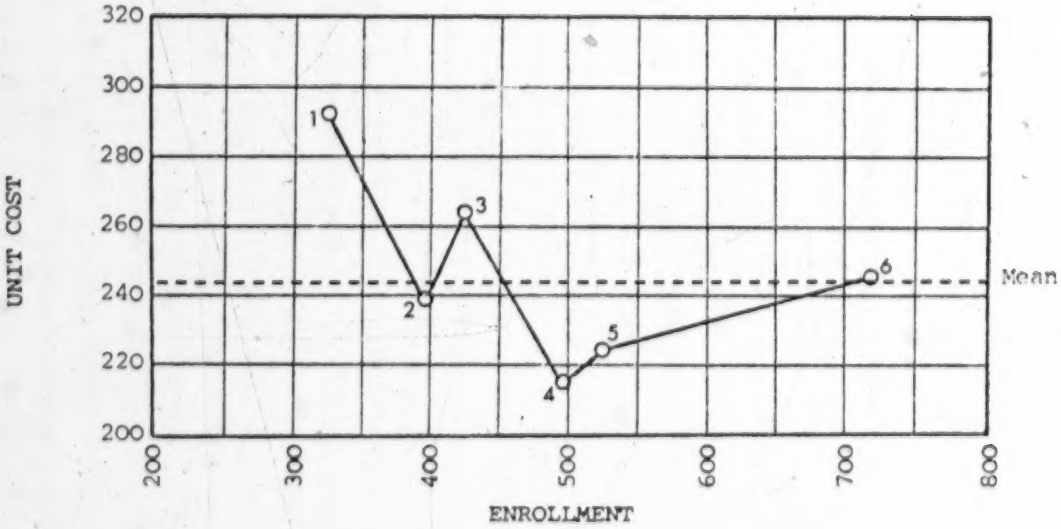

Figure 14

UNIT COSTS - PERSONAL EMOLUMENTS (JUNIOR SUBORDINATE STAFF)

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	87,199	328	265
2. Thika	103,968	398	261
3. Machakos	108,996	426	255
4. Rift Valley	135,700	497	273
5. Kisumu	164,284	522	314
6. Kabete	195,260	718	271
Totals/Mean	795,407	2,889	275

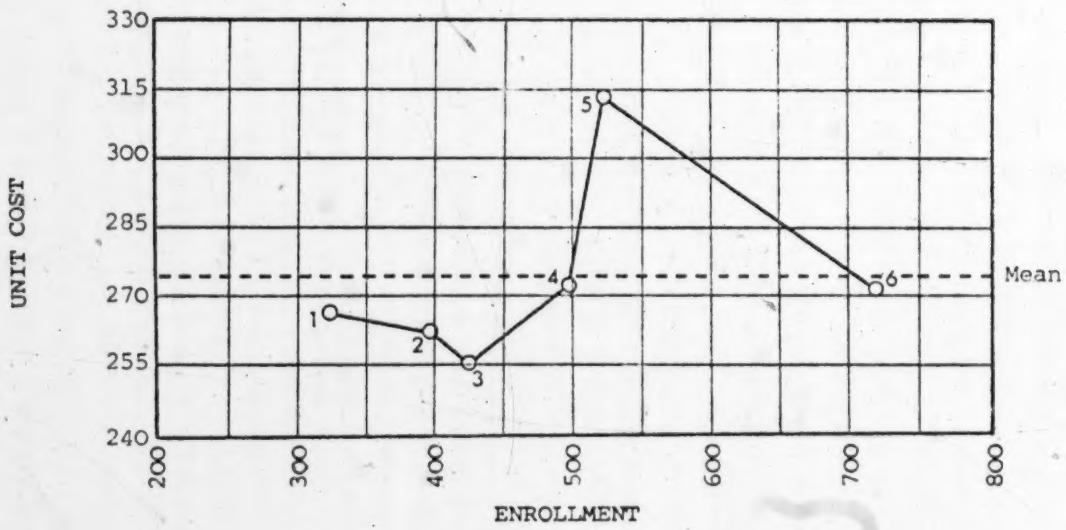

Figure 15

UNIT COSTS - TUITION, EQUIPMENT, AND STORES

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	212,322	328	647
2. Thika	267,856	398	673
3. Machakos	244,242	426	573
4. Rift Valley	329,115	497	662
5. Kisumu	408,373	522	782
6. Kabete	446,159	718	621
Totals/Mean	1,908,067	2,889	660

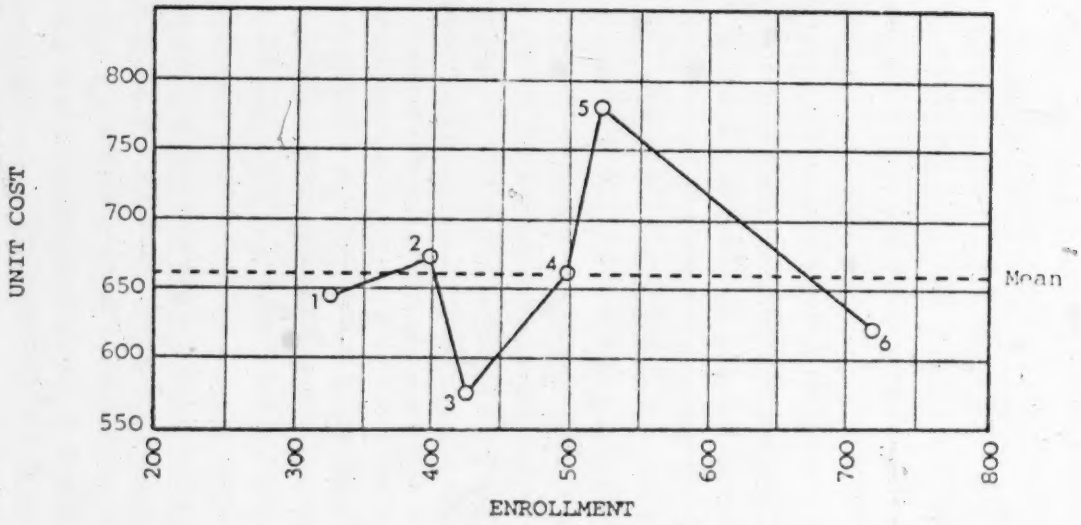

Figure 16

UNIT COSTS - BOARDING, EQUIPMENT, AND STORES

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	24,271	328	74
2. Thika	14,110	398	35
3. Machakos	23,748	426	55
4. Rift Valley	28,809	497	57
5. Kisumu	28,748	522	55
6. Kabete	31,686	718	44
Totals/Mean	151,372	2,889	52

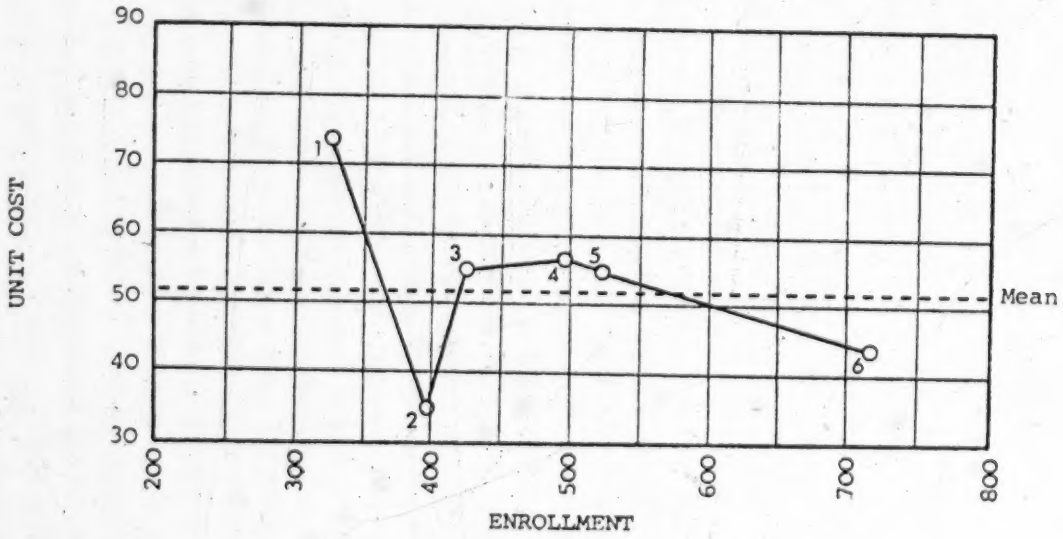

Figure 17

UNIT COSTS - LOCAL TRANSPORT, AND TRAVEL

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	33,563	328	102
2. Thika	89,957	398	226
3. Machakos	46,580	426	109
4. Rift Valley	39,861	497	80
5. Kisumu	57,302	522	109
6. Kabete	142,357	718	198
Totals/Mean	409,620	2,889	142

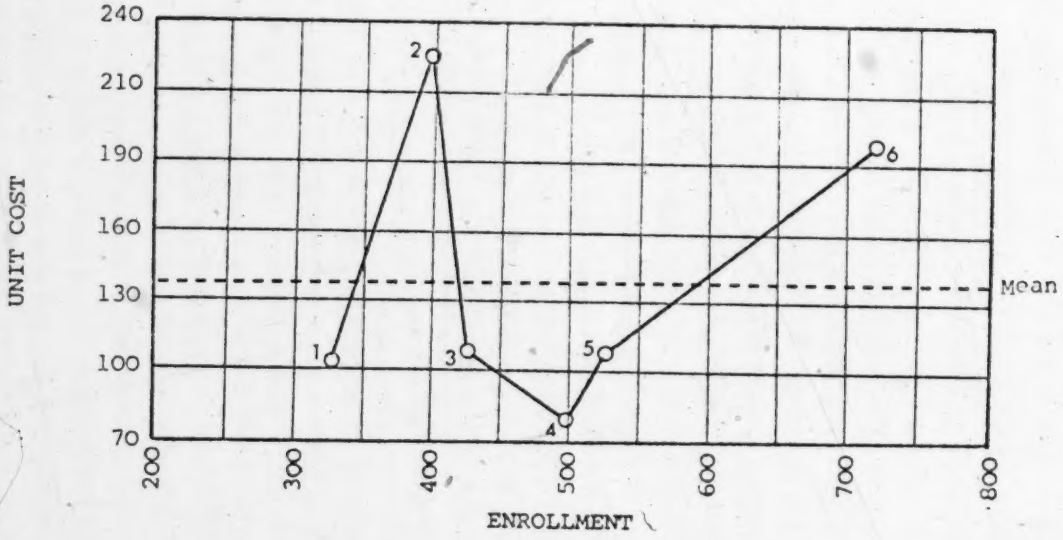

Figure 18

UNIT COSTS - ELECTRICITY, WATER, AND CONSERVANCY

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	20,422	328	66
2. Thika	24,941	398	62
3. Machakos	13,831	426	32
4. Rift Valley	29,903	497	60
5. Kisumu	27,865	522	53
6. Kabete	35,839	718	49
Totals/Mean	152,801	2,889	53

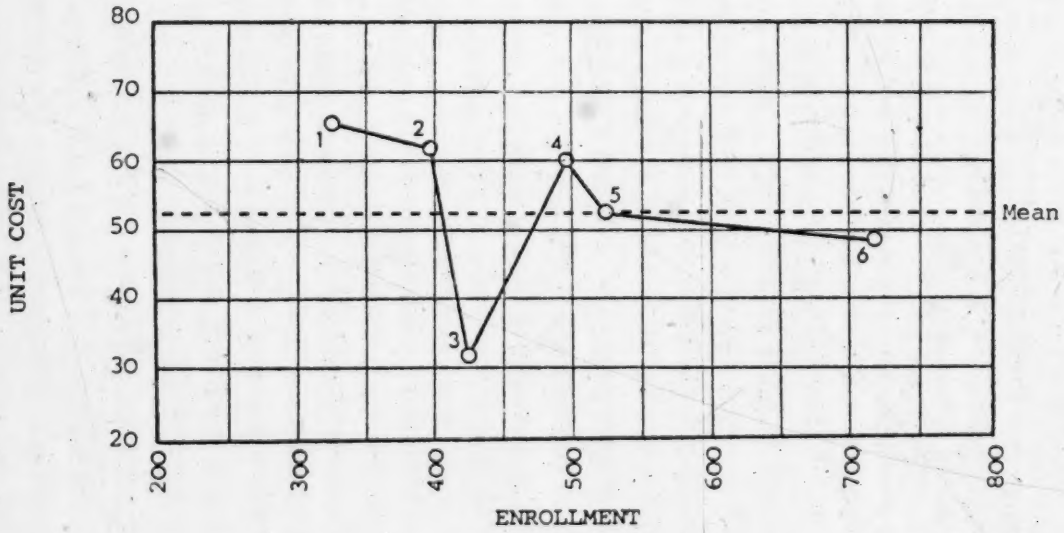

Figure 19

UNIT COSTS - CONTINGENCIES

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	17,049	328	51
2. Thika	22,935	398	57
3. Machakos	24,273	426	56
4. Rift Valley	32,216	497	64
5. Kisumu	41,277	522	79
6. Kabete	39,079	718	54
Totals/Mean	176,829	2,889	61

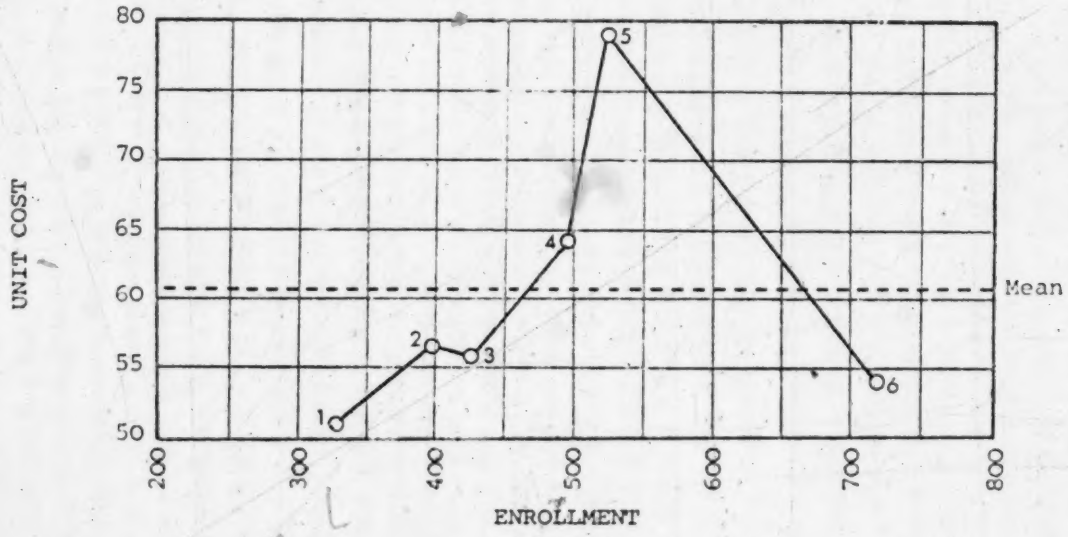

Figure 20

UNIT COSTS - REPAIRS, MAINTENANCE, AND IMPROVEMENT

this category was a major factor in causing Thika's high aggregate unit cost. Figure 21, which illustrates aggregate costs by school exclusive of professional salaries, shows Thika very near the mean.

Unit costs and enrollment. Enrollment appeared to have some relationship to unit costs both in the aggregate and by category. Two schools, Machakos and Rift Valley, incurred the lowest unit costs in most major cost categories. This is shown clearly in Figures 21 and 22 which illustrate unit costs with and without professional staff salaries. The graph in Figure 21, which excludes professional salaries, illustrates a very definite cost reduction for operating the two schools in the 400 to 500 enrollment range.

Summary

This chapter presented the unit costs that were required by the two major questions in the study. Trends and limitations of the data were discussed in relation to the specific sets of costs. Many limitations were noted but a number of these could be overcome by replicating this study on an expanded population over a number of years. A trend to reduced costs for subject options with higher enrollments was evident. Aggregate unit costs were lowest in schools with enrollments of 400 to 500.

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	569,561	328	1,736.47
2. Thika	691,221	398	1,736.74
3. Machakos	654,742	426	1,536.95
4. Rift Valley	765,717	497	1,540.68
5. Kisumu	964,454	522	1,847.61
6. Kabete	1,356,278	718	1,888.97
Totals/Mean	5,001,973	2,889	1,731.38

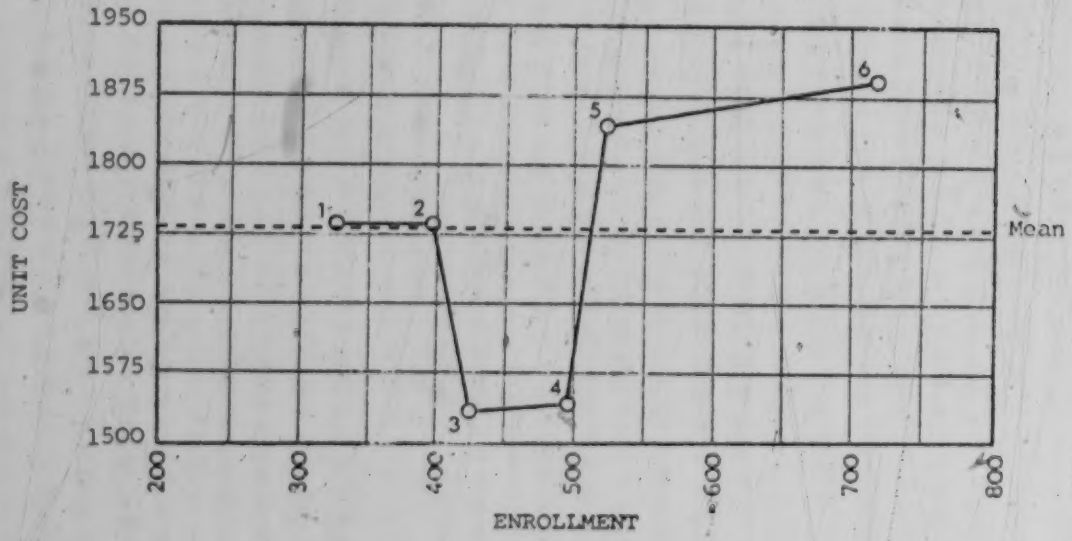

Figure 21

UNIT COSTS - TOTAL EXPENDITURES (EXCLUSIVE OF PROFESSIONAL SALARIES)

SCHOOL	EXPENDITURE K.SHS.	ENROLLMENT	UNIT COST
1. Meru	956,465	328	2,916
2. Thika	1,334,889	398	3,353
3. Machakos	1,056,082	428	2,467
4. Rift Valley	1,353,728	497	2,723
5. Kisumu	1,703,294	522	3,263
6. Kabete	2,093,038	718	2,915
Totals/Mean	8,497,496	2,889	2,941

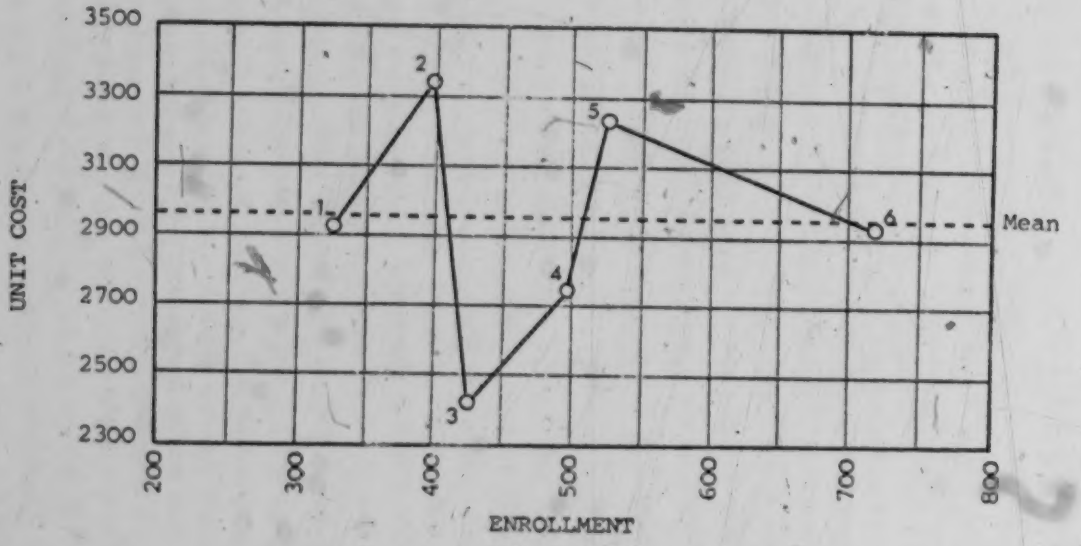

Figure 22

UNIT COSTS - TOTAL OPERATING EXPENDITURE

Chapter V

The purposes of this study were to (a) develop a model, the use of which would assist planners by increasing their knowledge of the operating cost implications of technical education programme options and institutional size alternatives in Kenya and (b) collect and analyse data on the 1975 operating costs of the Technical Education Programme. The first purpose was fulfilled by defining a cost structure, cost categories, and proration methods that served adequately in Kenya. This cost structure was then implemented by developing procedures and instruments and collecting data from the six technical schools which had fully implemented the programme in 1975. The collection and analysis of data was in effect, a test of the model.

Unit Cost Analysis Model

Little can be concluded in regard to the model developed in this study except that it served its purpose adequately. Because the cost categories were based, where possible, on the recommended accounts for the Kenyan schools no difficult cross-over of categories was required. The number and detail of the categories had to be reduced when it was discovered that only nine major account headings were actually in use in the schools. However, if and when more detailed accounting becomes standard practice in the schools, more refined and detailed categories can easily be accommodated within the structure of the model.

Potentially, unit cost analyses of the Kenya Technical Schools can provide outputs that could be useful to staff at all levels in the system. For such uses, however, the results of the analyses should be more reliable than those produced in a single year. This study developed and tested a model that could be applied from 1976 onward. Consistent, comparable data would then be available for the following purposes:

1) for planners who require projections of the operating cost implications of capital expansion plans.

2) for administrators who require data on actual expenditures in order to assess future budget requirements.

3) for administrators, inspectors, and supervisors for whom comparable unit costs would add a useful dimension to school to school comparisons of performance. If these cost figures are used judiciously and in a positive way they can lead to the identification of more efficient methods or help to identify reasons for poor results. Examples where unit cost analysis can help to identify causes of poor performance would be in the categories of professional staff salaries and instructional materials. Expenditures in these categories that are considerably below the mean should be investigated if they are coincident with poor performance. Investigation may reveal inadequate staffing, timetabling, or provision of materials. These two aspects are of particular importance in the practical courses in technical schools as students in these courses cannot develop the required practical skill unless they have the opportunity to practice on real materials for adequate periods under expert supervision.

4) for Headmasters and department heads to assist in assessing their requirements and to allocate internal budget funds.

The model is schematically represented in Figure 23.

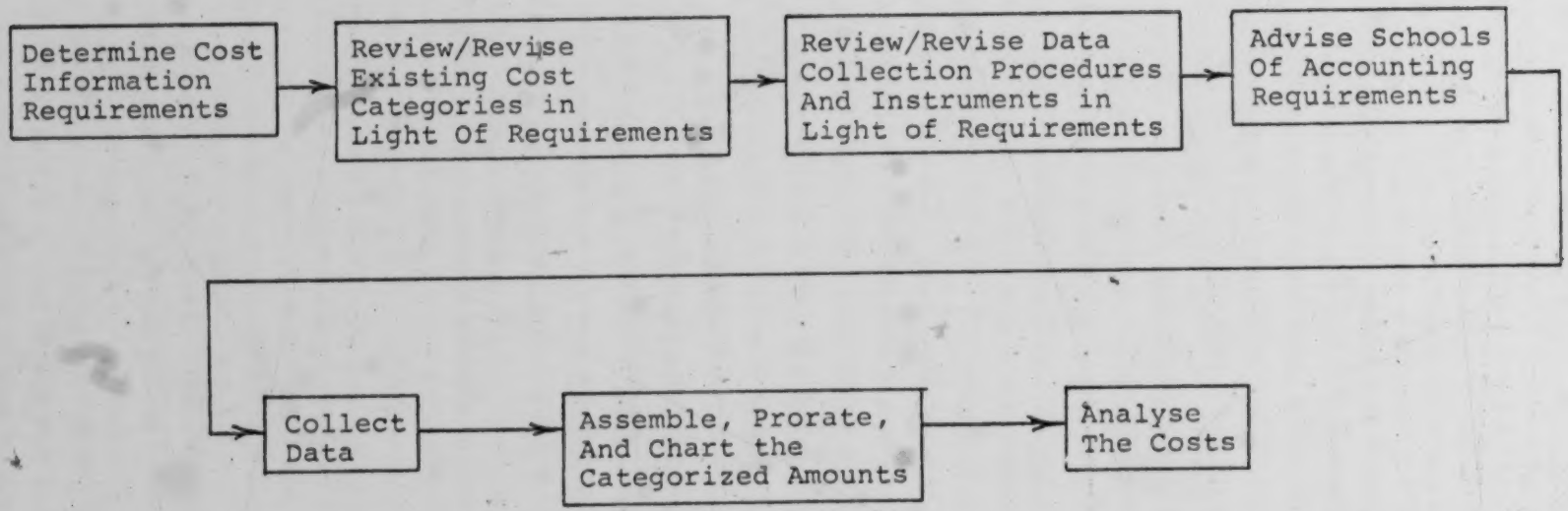
Determine Cost Information Requirements
Review/Revise Existing Cost Categories in Light Of Requirements
Review/Revise Data Collection Procedures And Instruments in Light of Requirements
Advise Schools Of Accounting Requirements
Collect Data
Assemble, Prorate, And Chart the Categorized Amounts
Analyse The Costs

Figure 23

OPERATING COST ANALYSIS MODEL

Recommendations for use of the model. It is suggested that this model could be used to advantage in successive years in the Kenyan Technical Schools, particularly if the schools are provided with assistance to implement a slightly more refined system of account categories. In the writer's assessment the small additional time and effort that would be required of department heads and bursars would make the collection of more reliable data simple and inexpensive.

Use of unit cost outputs from the application of this model must be made with care. Use of these data by persons or departments that do not appreciate the limitations or the exact nature of the figures could cause problems by fostering incorrect assumptions. It is therefore recommended that the results of this and similar future studies be properly explained to the potential users described in the section "Implications for use of the model" and that release of the information to persons external to the Ministry be carefully controlled. By implementing this recommendation the benefits of cost analysis should be available without causing any detracting misinterpretation.

1975 Unit Operating Costs

These costs, presented and analysed in Chapter IV, resulted from the application of the model developed in Chapters I and II. Many limitations of the data are cited

throughout the preceding chapters and the following conclusions are discussed within the perspective of these limitations.

Unit operating costs of the seven technical subject options. These unit costs, when compared on the basis of enrollment, showed definite economies of scale. On the basis of enrollment two groups of school/options were identified in the total of 19 studied. Those with enrollments of between 44 and 60 incurred a mean unit cost of 536 shillings lower than the group with enrollments between 16 and 30. It was concluded that, on the basis of this study, unit costs are considerably less for enrollments over 40 in any particular option.

Aggregate operating costs. Analysis of the differences among the aggregate unit operating costs of the six technical schools determined a range of from 2,467 at Machakos to 3,353 at Thika. The mean was 2,941. Professional staff salaries was the largest single cost component, comprising approximately one third of the total unit costs. Two schools with enrollments in the mid-range incurred considerably lower unit costs in all major categories than the other four schools.

The limitations of this study preclude firm conclusions on the basis of data from a single year. If, however, replication of this study on a larger population were to produce similar figures, there would be distinct

implications for planners considering cost and institutional size alternatives. It can be concluded that data produced by this study would be useful in identifying extreme cost variations. Knowledge and investigation of these extreme variations can help administrators avert budgetary problems and perhaps take corrective action that may avoid more serious problems later.

Implications of the use of unit costs. This study indicates that it is possible to identify the most economic enrollments for both single options and whole schools. These enrollments should be verified by longitudinal studies with larger populations but, all other factors being equal, they would indicate the most economical option and school enrollments. This information should then be one of the factors to be considered when determining the eventual size and enrollment patterns of technical schools.

Recommendations from the analysis. It is recommended that Kenya technical schools proceed cautiously with any plans to implement low-enrollment options or to implement programmes in schools with enrollments of less than 400. It is also recommended that extreme variations in cost categories be investigated.

Summary

This study successfully developed and implemented a model for studying unit operating costs in Kenya's

technical schools. The first application of this model was to study the 1975 costs. 1975 was an opportune year to begin such a study because it was the first year that the new Technical Education Programme had been fully implemented in six of the schools. Because of the newness of the programme and the lack of complete, accurate accounts the resulting data had severe limitations and the conclusions await verification by longitudinal replication of the study. The model and the outputs both appeared to be useful. Similar yearly analyses were recommended to the Ministry as relatively easy and inexpensive to conduct.

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APPENDIX A

Kenya Technical Education Programme

Introduction

This programme was developed in Kenya after trials of a number of other approaches. In 1975 the programme had been started in nine schools and this number was expected to rise to at least twelve.

The unpredictable nature of labour requirements during Kenya's rapid development and the fickle manner in which economic pressures affect these requirements were prime factors influencing the design of the programme. The format of this four year course provided for an output of manpower that was not narrowly skilled but possessed a high degree of "trainability". The graduates obtained (a) a sound core of five E.A.C.E.* level academic subjects, (b) a general background in either engineering or building trades, and (c) one year of intensive skill training in a specialist area. The academic core was intended to give the student the competence in language, mathematics, and science requisite to further technological training. The general trade experiences were intended to give the student a working knowledge of the broad trade area (either building or engineering) so that he could relate to it intelligently and appreciate the scope of his involvement. This

* "East African Certificate of Education" - comparable to British "O" level.

general background was developed in Forms I to III and provided the student with a sound basis for making his choice of specialist training in Form IV. The specialist skill training was carried out during the fourth year of the programme. Finals were offered in mechanical, electrical, automotive, and agricultural mechanics in the Engineering Schools. A specialist year for welders and draftsmen was anticipated for the future. Finals were offered in carpentry/joinery, plumbing and masonry in the Building Schools.

The graduates of the Technical Education Schools had the following opportunities:

1) to enter employment directly.

2) to enter employment and be sponsored to a Ministry of Labour programme for craft or technician certification. Usually a credit of up to two years was granted towards this indenture on the basis of the technical school training thus shortening considerably the time required to gain full trade certification.

3) to enter employment and be sponsored to technician training at the polytechnics or other higher level institutions. Here the student was well qualified because of an initial technical background and a sound academic core.

4) to sponsor himself for further training at one of the Harambee Technical Institutes which offer continuing higher level courses without employer sponsorship.

5) to carry on to Form V and VI with the hope of entering the Faculty of Engineering at University. (The potential of this route was being tested in 1975 by 2 classes at Mombasa Polytechnic). It was hoped to provide an opening for approximately fifty of

> the most outstanding graduates of the technical schools each year to enter Forms V and VI and, potentially, carry on to a technically biased university degree.

Details of The Technical Education Programme

Prior to 1972 the Technical Education Programme varied almost from year to year as the schools opted for a variety of City and Guilds of London courses and paid little attention to academic offerings. In 1972 the programme was extended to four years and the courses incorporated into the E.A.C.E. The time allocations were as shown in Figure 23. One credit toward the East African Certificate of Education was awarded for each of the subjects offered in Form IV.

The programme for all students was common in Forms I and II. At the end of Form II the students opted for specialization in either the Engineering Trades Courses or the Building Trades Courses. Form III consisted of technology and general practical experience in all of the trade areas in either the Building Trades or the Engineering Trades. Form IV consisted of technology and practical skill development in one area of specialization. This specialization was in one of either Mechanical, Electrical, Automotive or Agricultural Mechanics in the Engineering Trades and either Carpentry/Joinery, Masonry, or Plumbing in the Building Trades.

The selection at the end of Form II was based on the student's performance in Forms I and II, the Headmaster's recommendation and the student's preference.

SUBJECT	E.A.E.C. GROUPING	PERIODS PER WEEK FORMS I & II	FORMS III & IV
Mathematics	IV	7	6
Science for Technical Students	V	6	6
English	I	8	8
Kiswahili	III	5	--
History	II	3	-
Geography	II	3	3
Technical Drawing	VII	3	5
Woodwork	--	5	-
Metalwork	--	5	-
Building or Engineering Technology	VII	-	3
Building or Engineering Applications	VII	-	14
TOTAL		45	45

Figure 24

TECHNICAL EDUCATION PROGRAMME

The following were the programme/school combinations for 1975.

Kabete Forms I to IV	Basic Engineering Trades with Mechanical, Automotive and Electrical Options. Basic Building Trades with Carpentry/Joinery, Masonry, and Plumbing options were slated to begin in 1976.
Kaiboi Forms I & II only	Common Program with Basic General Shopwork. Form III was slated to begin in 1976.
Kisumu Forms I to IV	Basic Engineering Trades with Mechanical, Automotive and Electrical Options.
Machakos Forms I to IV	Basic Engineering Trades with Mechanical, Automotive, and Electrical Options.
Mawego Forms I & II only	Common Program with Basic General Shopwork.
Meru Forms I to IV	Basic Building Trades with Carpentry/Joinery, Plumbing, and Masonry.
Rift Valley Forms I to IV	Basic Engineering Trades with Mechanical Electrical and Automotive Options.
Sigalagala Forms I to IV	Basic Building Trades with Carpentry/Joinery, Masonry, and Plumbing Options. (NOTE: This school was just phasing in the programme. Therefore, only the 1974 Form I intake had started the programme.)
Thika Forms I to IV	Basic Engineering Trades with Mechanical, Electrical, Automotive and Agricultural Mechanics Options.

Class Size and Subject Period Breakdown

The following conditions plus the period allocations Figure 24 represented the optimum programme situation which was to be implemented as early as staff and facilities permitted. These conditions were deemed essential to the achievement of the full potential of the Technical Education Programme and, as such, formed the basis of the capital and curricular development work for future years.

Period allocations. In all Forms the class size was to be 36 for classroom/drawing room periods and 18 for workshop/science lab periods. Science was conducted approximately 2 periods per week in the classroom and 4 periods per week in the laboratory. The Basic Engineering Trades Course and the Basic Building Trades Course periods were apportioned in the following manner: (a) Forms I and II received a commom programme consisting of 8 periods per week practical (4 wood and 4 metal) plus 2 periods per week theory (1 wood and 1 metal).

E.A.C.E. Basic Engineering Trades Applications. This course was allocated 14 periods per week: 7 periods Mechanical, 3 periods Electrical, and 4 periods Automotive or Agricultural Mechanic.

E.A.C.E. Basic Engineering Trades Technology. This course was allocated 3 periods per week, 1 period each of Mechanical, Electrical, and Automotive.

FORM	I	II	III ENG.	IV ENG.	III BUILD.	IV BUILD.
CLASSROOM	30	30	22	22	22	22
SCIENCE LAB	8	8	8	8	8	8
JUNIOR WOODSHOP	8	8	-	-	-	-
JUNIOR METALSHOP	8	8	-	-	-	-
DRAWING OFFICE	3	3	5	5	5	5
MECHANICAL WORKSHOP	-	-	10	20	-	-
WELDING WORKSHOP	-	-	4	8	-	-
ELECTRICAL WORKSHOP	-	-	6	28	-	-
AUTOMOTIVE WORKSHOP	-	-	8	28	-	-
AGRIC. MECH. WORKSHOP	-	-	8	28	-	-
MULTI-PURP. WORKSHOP	-	-	-	-	-	-
PLUMBING WORKSHOP	-	-	-	-	8	28
CARP./JOIN. WORKSHOP	-	-	-	-	12	28
MASONRY WORKSHOP	-	-	-	-	8	28
TOTAL PER STUDENT	45	45	45	45	45	45
TOTAL TUITION TIME	57	57	63	63	63	63

Figure 25

TECHNICAL SCHOOL
FACILITIES REQUIREMENTS PER STREAM PER COURSE

E.A.C.E. Basic Building Trades Applications. This course was allocated 14 periods per week: 6 periods Carpentry/Joinery, 4 periods Plumbing, and 4 periods Masonry.

E.A.C.E. Basic Building Trades Technology. This course was allocated 3 periods per week, 1 period per week in each of Carpentry/Joinery, Plumbing and Masonry.

Form IV. The fourth year of the Technical Programme consisted of 14 workshop periods per week in one specialty option of either the Basic Engineering Trades Applications Course or the Basic Building Trades Applications Course. Three periods per week were required in the corresponding technology course.

Kenya Technical Schools
Unit Cost Analysis

PROFESSIONAL STAFF SALARY - COST PER OPTION

SCHOOL _____

OPTION _____

Name	Total Teaching Load	P.P.W. In Option (Form IV)	Total Salary	Allocable Cost
			TOTAL	

SCHOOL _____

OPTION _____

Name	Total Teaching Load	P.P.W. In Option (Form IV)	Total Salary	Allocable Cost
			TOTAL	

Kenya Technical Schools
Unit Cost Analysis

INSTRUCTIONAL MATERIALS EXPENDITURES - 1975

SCHOOL _____

Option (Form IV)	No. of Students	Materials Expenditures			Unit Cost
		Actual Recorded	Estimated	Total	

Materials costed above must be only those that were used for or by the Form IV students in the above option.

Where actual recorded costs of materials were available for materials used exclusively in Form IV the amounts should be entered under "Actual Recorded". For materials and supplies which were partially used by Form IV the Form IV portion must be estimated and placed in the appropriate column.

Common stationery items as used in most classes (i.e. paper, ink, notebooks, pencils, erasers, etc.) should not be included. Samples of items which must be included are:

Mechanical
- all metal stock
- all fasteners
- tools with a single item value of less than 1000/- purchased in 1975
- blades, drills, files
- lubricants

Electrical
- wire, cable, conduit
- terminals, switches, fittings
- gas for torches
- solder
- tools with a single item value of less than 1000/- purchased in 1975
- blades, drills,
- nails, screws, bolts
- fasteners

Automotive/Ag. Mech.
- spare parts
- petrol, solvent, oil, grease
- gasket material
- tools with an item value of less than 1000/- purchased in 1975
- patches, tubes, tires
- screws, bolts
- files, blades, drills
- wire, terminals

Carpentry/Joinery
- wood, synthetic
- fasteners, glue
- blades, drills,
- tools with an item of less than 1000/- purchased in 1975
- finishes
- solvents, brushes

Plumbing
- pipes, fittings
- tools/equipment with an item value of less than 1000/- purchased in 1975
- lead, solder
- welding supplies
- sheet metal
- solvents

Masonry
- bricks, blocks, stone
- sand, gravel, ballast
- tools/equipment with an item value of less than 1000/- purchased in 1975
- blades, drills, files
- hoses, pails
- cement, lime

Kenya Technical Schools
Unit Cost Analysis

MAINTENANCE AND REPAIR EXPENDITURE PRORATION
1975

SCHOOL _____

Dept. Option	No. of Wkshops	Total P.P.W. Workshops Timetabled	P.P.W. Workshops Used for Form IV Option	% Time	Total M. & R. Exp. For Dept.	Prorated M. & R. Expend.
	1	2	3	4	5	6
Mech.						
Elec.						
Auto.						
Ag. M.						
Carp/J.						
Plum.						
Masonry						

Notes:

Columns 1, 2, and 3 should be completed by the relevant Department Heads.

Column 1 - simply count the number of workshops used by the department.

Column 2 - count the number of periods per week each workshop included in Column 1 was timetabled for use. Add these and enter the total.

Column 3 - count the number of periods per week each workshop included in column 1 was used for Form IV instruction. Add these and enter.

Columns 4, 5, 6 will be completed by the accountant.

Kenya Technical Schools
Unit Cost Analysis

TECHNICAL SUBJECT OPTION EXPENDITURES BY SCHOOL

UNIT COSTS OPTION - Mechanical

OPTION	ENROLLMENT	PROF. SALARIES	INSTR. MATERIALS	REPAIR & MAINTA.	TOTAL UNIT COST
Thika					
Machakos					
Rift Valley					
Kisumu					
Kabete					

UNIT COSTS OPTION - Electrical

SCHOOL	ENROLLMENT	PROF. SALARIES	INSTR. MATERIALS	REPAIR & MAINTA.	TOTAL UNIT COST
Thika					
Machakos					
Rift Valley					
Kisumu					
Kabete					

Kenya Technical Schools
Unit Cost Analysis

TECHNICAL SUBJECT OPTION EXPENDITURES
BY SCHOOL

UNIT COSTS OPTION - Automotive

SCHOOL	ENROLLMENT	PROF. SALARIES	INSTR. MATERIALS	REPAIR & MAINTA.	TOTAL UNIT COST
Thika					
Machakos					
Rift Valley					
Kisumu					
Kabete					

UNIT COSTS OPTION - Ag. Mechanical

SCHOOL	ENROLLMENT	PROF. SALARIES	INSTR. MATERIALS	REPAIR & MAINTA.	TOTAL UNIT COST
Thika					

UNIT COSTS OPTION - Carp/Join.

SCHOOL	ENROLLMENT	PROF. SALARIES	INSTR. MATERIALS	REPAIR & MAINTA.	TOTAL UNIT COST
Meru					
Kabete					

Kenya Technical Schools
Unit Cost Analysis

TECHNICAL SUBJECT OPTION EXPENDITURES
BY SCHOOL

UNIT COSTS OPTION - Plumbing

SCHOOL	ENROLLMENT	PROF. SALARIES	INSTR. MATERIALS	REPAIR & MAINTA.	TOTAL UNIT COST
Meru					
Kabete					

UNIT COSTS OPTION - Masonry

SCHOOL	ENROLLMENT	PROF. SALARIES	INSTR. MATERIALS	REPAIR & MAINTA.	TOTAL UNIT COST
Meru					
Kabete					

Kenya Technical Schools

UNIT COST ANALYSIS

VOTE HEAD .....

School	Expenditure K.Shs.	No. of Students	Unit Cost
Meru			
Thika			
Machakos			
Rift Valley			
Kisumu			
Kabete			
TOTALS			

VOTE HEAD .....

School	Expenditure K.Shs.	No. of Students	Unit Cost
Meru			
Thika			
Machakos			
Rift Valley			
Kisumu			
Kabete			
TOTALS			

Kenya Technical Schools
Unit Cost Analysis

SCHOOL _____

GENERAL INFORMATION SURVEY

I. 1975 ENROLLMENT - TOTAL _____

FORM 1	____	FORM 2	____
FORM 3 BUILDING	____	FORM 3 ENGINEERING	____
FORM 4 OPTIONS			
Mechanical	____	Carp./Join.	____
Electrical	____	Plumbing	____
Automotive	____	Masonry	____
Ag. Mech.	____		

II. ESTABLISHMENT 1975

(a) Professional

Headmaster	____
Deputy-Head	____
Teachers	____
Other (specify)	
_____	____
_____	____
_____	____

(b) Subordinate/Support

Bursar	___	Security	___
Technicians	___	Cleaners	___
Artisans	___	Drivers	___
Dresser	___	Caterer/ess	___
Storekeeper	___	Cooks	___
Groundsmen	___	_____	___
Others (specify)	_____		___
	_____		___
	_____		___
	_____		___

(c) Non-Teaching Professional: List all teachers including any Headmaster or Deputy Head who were not regularly scheduled to teach.

Name	Duties
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

General Information Survey - cont'd.

III. STAFF VACANCIES

(a) PROFESSIONAL STAFF VACANCIES - Complete a separate form for each position which was wholly or partially vacant in 1975.

Position _____

No. of Months Vacant _____

ALLOCATED DUTIES WOULD HAVE BEEN			DURING THE PERIOD OF VACANCY THESE DUTIES WERE		
Course	Level	Periods Per week	Left Unattended	Carried by Other Staff	Performed by a Specially Employed Substitute
_____	___	_____	_____	_____	_____
_____	___	_____	_____	_____	_____
_____	___	_____	_____	_____	_____
_____	___	_____	_____	_____	_____
Other (specify and estimate hours per week)					
_____			_____	_____	_____
_____			_____	_____	_____
_____			_____	_____	_____

(b) SUBORDINATE/SUPPORT STAFF - Complete the following information about all wholly or partially vacant positions in 1975.

Position	Annual Salary Range for Position	No. of Months Vacant
_____	K£. _____ to K£. _____	_____
_____	K£. _____ to K£. _____	_____
_____	K£. _____ to K£. _____	_____
_____	K£. _____ to K£. _____	_____
_____	K£. _____ to K£. _____	_____
_____	K£. _____ to K£. _____	_____
_____	K£. _____ to K£. _____	_____
_____	K£. _____ to K£. _____	_____
_____	K£. _____ to K£. _____	_____

Kenya Technical Schools
Unit Cost Analysis

SCHOOL _____

TEACHING STAFF WORKLOAD SURVEY

Complete the following information for each staff member including Headmaster and Deputy Head who taught regularly on the timetable in 1975.

NAME: ..... DEPARTMENT .....

NO. OF MONTHS ON STAFF IN 1975 _____ (inclusive of school holidays)

	SUBJECTS TAUGHT	LEVEL	PERIODS PER WEEK	SALARY CLASSIFICATION ..... ANNUAL SALARY K£. ..... OTHER ASSIGNED DUTIES
1.	_____	_____	_____	_____
2.	_____	_____	_____	_____
3.	_____	_____	_____	_____
4.	_____	_____	_____	_____
5.	_____	_____	_____	
	TOTAL			

SCHOOL _____

Complete the following information for each staff member including Headmaster and Deputy Head who taught regularly on the timetable in 1975.

NAME: ..... DEPARTMENT .....

NO. OF MONTHS ON STAFF IN 1975 _____ (inclusive of school holidays)

	SUBJECTS TAUGHT	LEVEL	PERIODS PER WEEK	SALARY CLASSIFICATION ..... ANNUAL SALARY K£. ..... OTHER ASSIGNED DUTIES
1.	_____	_____	_____	_____
2.	_____	_____	_____	_____
3.	_____	_____	_____	_____
4.	_____	_____	_____	_____
5.	_____	_____	_____	

Kenya Technical Schools
Unit Cost Analysis

TECHNICAL SUBJECT OPTION EXPENDITURES
SCHOOL SUMMARIES

EXPENDITURE/UNIT COST SCHOOLS _____

OPTION	ENROLLMENT	PROF. SALARIES	INSTR. MATERIALS	REPAIR & MAINTA.	TOTAL UNIT COST

EXPENDITURE/UNIT COST SCHOOLS _____

OPTION	ENROLLMENT	PROF. SALARIES	INSTR. MATERIALS	REPAIR & MAINTA.	TOTAL UNIT COST